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A SYNOPSIS OF THE NORTH AMERICAN SPECIES OF SORBUS

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With plates 226 and 227

SORBUS, THE MOUNTAIN-ASH, is a genus of vascular plants belonging to the subfamily Pomoideae of the Rosaceae. In all, including CORMUS, ARIA and MICROMELES, there are approximately 80 species (Rehder, Man. Cult. Trees Shrubs, 1927) distributed throughout the northern hemisphere. Many are of economic importance as ornamental shrubs. They are attractive especially when in bloom, with large compound terminal corymbs of fragrant white flowers early in the season, and showy, usually red, fruits in the autumn and winter. A great deal of confusion exists as to the identity, specific limits, nomenclature, and geographical distribution of the North American species. It is the purpose in this paper to attempt a taxonomic revision in the form of the following short synopsis.

The subfamily Pomoideae Focke consists of a group of genera of ligneous plants with the ovary inferior and the fruit a pome. Many of the genera are very closely related to one another, and a number of natural hybrids are known to occur between them. Apparently they had a common origin, and it seems probable that all originated by genetic change within the basic set of 17 chromosomes, and that various degrees of chromosome differentiation now exist in the different genera (Sax, K., Jour. Arnold Arb. 1931). Hybrids are known to occur between *Aronia* and *Sorbus, Amelanchier* and *Sorbus,* and between *Pyrus* and *Sorbus;* a hybrid between *Malus* and *Sorbus* has been reported (*Bollwilleria malifolia* Zabel, Mitt. Deutsch. Dendr. Ges. 16: 76. 1907, nom. nud.) but no plants or specimens of such a hybrid seem to exist. There is no record of hybridism between *Malus* and *Pyrus,* although

these genera are morphologically very similar and have been cultivated side by side for thousands of years with the consequent ample opportunity for such hybrids to occur.

In view of the close relationship between these genera it is often a difficult matter to outline a satisfactory taxonomic arrangement. Each generic group, though sharing the well known characteristic of some other members of the Rosaceae in being rather deficient in those fundamental conservative morphological characters that are commonly accepted by botanists as of primary importance, is nevertheless very distinct in appearance and habit from its near relatives. *Sorbus* forms an extremely natural genus, and in view of the marked differences in the flowers, inflorescences, fruits, and foliage, it is difficult indeed to see why it should be included with the pears and apples. However, suggestion has been made recently that the Pomoideae be reduced to one genus, on account of this obvious close relationship, but both the demands of a practical taxonomy, as well as a sound basis in physiology and morphology, indicate that the various recognizable natural units in this subfamily are probably better maintained as separate genetic and generic entities, as they have been in the main for between one and two centuries. This conclusion has been accepted by the most eminent students of this group since the time of Linnaeus.

All the North American species of *Sorbus* belong to Section AUCUPARIA (Med.) K. Koch, of which most of the members are Asiatic. They are characterized by their odd-pinnate leaves, their 2–5 carpels which are not completely connate, and by the small, usually numerous, chiefly red, berry-like fruits, which lack or have only very few stone-cells.

In this paper 11 species and one variety of *Sorbus* are recognized, described and attributed to North America and Greenland. The important structural features used in the characterization of the species are the size and number of the flowers; the size, color, shape, and the number of the fruits; the size and shape of the inflorescence; the relative length of stamens and petals; the number and length of the styles; and the shape, size, and color of the seeds. The seeds of most species are distinctive and specifically recognizable, but their characteristics are difficult to describe in words. Although there is a certain amount of variation in the degree of flattening depending upon the number that mature in one pome, the size, shape, color, and dimensions of the mature seeds are apparently constant for a given species. This number varies from one to five in the material examined. The leaves furnish very good specific characters. The number, shape, size, texture, indument, and serration of the leaflets are definite. The glossiness or dullness of the upper

surface of the leaflets is a fundamental and fixed character of considerable diagnostic value, very useful in the identification of living plants. Although the lustre is to a great extent lost in herbarium specimens, the practised eye can detect its presence on specimens of those species which have it, and thus this character is of some value in studying dried material as well. Usually, the species with glaucescent fruits have dull leaflets, and conversely, those with glossy leaflets have lustrous scarlet pomes. There are a few exceptions to this rule, for example, *S. sambucifolia* has glossy leaflets, but glaucous fruits. However, as is remarked elsewhere, this is scarcely a North American type. Other characters used in differentiating species are the habit of the plant, whether arborescent or merely frutescent, and the presence, absence, and kind of pubescence on the pedicels, peduncles, rachises, and leaf-buds. The value of a taxonomic character increases with its constancy, and a character such as pubescence may have in certain groups a considerable, and perhaps unsuspected phyletic value. Differences in geographical distribution are of course not treated as taxonomic characters, but the species herein described are found to occupy definite and natural ranges and life-zones. Most of the North American "species" as treated in the past have exhibited discontinuous distribution and phytogeographical anomalies, suggesting to the competent phytogeographer the probability of more than one specific unit being involved in certain of these aggregates.

Intermediate between *Sorbus* and the closely related genus *Aronia,* and apparently representing intergeneric hybrids, are occasional specimens collected in the region between Newfoundland and Massachusetts. Similar hybrids have been known in European gardens for about 150 years. The leaves of these plants are pinnate, pinnatifid, or lobed, or merely serrate, the inflorescence is of the Aronia type, and the fruits are black, purple, or red. According to Schneider, and to Rehder, these plants belong to the hybrid genus × *Sorbaronia* Schneid. Four such intergeneric hybrids between feral North American mountain-ashes and chokeberries are known. In this paper they are discussed or mentioned under *S. americana, S. aucuparia,* and *S. decora.* A single hybrid between *Sorbus* and *Amelanchier* is known from Idaho and Oregon. It has been described by Rehder as × *Amelasorbus,* and is discussed in this paper under its Sorbus-parent, *S. scopulina.*

One or more species of *Sorbus* occur in nearly every part of the North American continent north of Mexico except the arctic regions, the area between long. 95° and 102°, and the southeastern part of the United States. No species occurs south of latitude 32° N. Only one mountain-ash, *S. decora* var. *groenlandica,* is known to be indigenous to Greenland.

The area from Newfoundland to Minnesota and southward to Michigan and North Carolina is occupied exclusively by the two native species, *S. americana* and *S. decora,* and the naturalized *S. aucuparia.* The remaining eight species are confined to the western half of the continent. *Sorbus scopulina* is the most widespread and abundant species in western North America, extending from British Columbia to New Mexico, and from South Dakota to eastern Washington, and eastern Oregon. *Sorbus dumosa* is a local, rather poorly known and much misunderstood species confined to Arizona and New Mexico. In the mountainous areas adjacent to the Pacific Coast there are three species, *S. californica, S. cascadensis,* and *S. occidentalis.* Extending from southern Alaska, across British Columbia, and southward to Glacier National Park, is *S. sitchensis. Sorbus alaskana* is a newly described species from Alaska. The Asiatic *S. sambucifolia* is scarcely a North American type, and is present in the western hemisphere, so far as is now known, on only four islands of the Aleutian chain. Thus it is apparent that each species has a natural and well-defined geographical area.

The principal recent works containing taxonomic studies of the genus *Sorbus* are by T. Hedlund in Kongl. Svenska Vetensk.-Akad. Handl., 1901; C. Schneider, Ill. Handb. Laubholzk. vol. 2, 1907; and A. Rehder, Man. Cultivated Trees Shrubs, 1927. There are treatments of the species of eastern Asia by E. Koehne in volume 1 of Sargent, Plantae Wilson. (1913), and by A. Rehder in the second volume (1916) of the same work.

In the enumeration of specimens on the following pages, the name of the herbarium from which the specimen came is indicated by the following parenthetical letters: (A) Arnold Arboretum, (CA) California Academy of Sciences, (Can) National Museum of Canada, (G) Gray Herbarium, (NE) New England Botanical Club, (NY) New York Botanical Garden, (UC) University of California, and (US) United States National Herbarium. Acknowledgment is here made to the curators of these herbaria for their courtesies. Special thanks are due Dr. Theodor Just of the University of Notre Dame for photographs of certain type-specimens, and to Professor Alfred Rehder for innumerable useful suggestions and criticisms.

KEY TO THE NORTH AMERICAN SPECIES OF SORBUS

Fruits 4–11 mm. in diameter at maturity; flowers 5–10 mm. broad; calyx 2–4 mm. long at anthesis.

Winter-buds densely whitish-villous; rachises, pedicels, and calyces usually copiously whitish pilose-pubescent at flowering time.

Tree, naturalized in North America; leaflets 11–15; inflorescence 75–100-flowered; fruit 9–11 mm. in diameter ....1. *S. aucuparia*

Shrub, native in the mountains of Arizona and New Mexico; leaflets 9–11; inflorescence 40–60-flowered; fruit 6–8 mm. in diameter... .....2. *S. dumosa*

Winter-buds glabrous or pilose, the trichomes whitish or ferrugineous. Leaflets 11–17; stipules caducous.

Winter buds glabrous (or the inner scales sometimes sparsely ciliate toward the tips); leaflets narrowly oblong-lanceolate to lanceolate, acuminate, finely serrate; fruits 4–6 mm. in diameter; flowers 4–6 mm. broad; tree (or shrub) eastern North America... .....3. *S. americana*

Winter-buds more or less pilose and ciliate; fruits 7–10 mm. in diameter at maturity; flowers 7–10 mm. broad.

Lateral leaflets lanceolate or oblong-lanceolate, acuminate to acute, usually three to five times as long as broad, finely serrate almost to the base, glossy above (when living); seeds oblong, 3.5–4 mm. long; western American shrubs.

Inflorescence normally flat-topped, 9–15 cm. broad, 80–200-flowered; species of the Rocky Mountain region..... .....4. *S. scopulina*

Inflorescence rounded, 3–6 cm. broad, less than 40-flowered; species of northwestern Alaska .....5. *S. alaskana*

Lateral leaflets oval or oblong, abruptly acute, seldom more than three times as long as broad, serrate to the middle or below, not glossy; seeds lanceoloid or fusiform, 4–5 mm. long; northeastern America and southern Greenland .....6. *S. decora*

Leaflets 7–11; stipules usually more or less persistent; shrubs, western America.

Leaflets serrate from apex to middle or below; styles 1–2 mm. long at anthesis.

Winter-buds greenish-brown, glutinous, glossy, glabrous or sparsely pilose; leaflets glossy above (when living); pedicels glabrous or sparsely pilose with short whitish trichomes.

Pedicels sparsely pilose; mature leaflets normally 5–7 cm. long, 2–3 cm. wide; winter-buds 7–15 mm. long, ciliate or sparsely pilose with whitish trichomes; petals 5–6 mm. long; British Columbia to northern California .....7. *S. cascadensis*

Pedicels glabrous; mature leaflets normally 2–4 cm. long, 1–2 cm. wide; winter-buds smaller (3–8 mm. long), glabrous, or the inner scales sparsely rufous-ciliate; petals 3–4 mm. long; California .....8. *S. californica*

Winter-buds dull, the reddish scales dorsally pilose with ferrugineous trichomes as well as marginally ciliate; pedicels ferrugineous-pilose at flowering time; leaflets dull; southeastern Alaska to northwestern Montana and northern Idaho. .....9. *S. sitchensis*

Leaflets entire except near the apex (rarely with a few teeth near the middle), oblong, obtuse; pedicels, petioles, and rachises finely rufous-pubescent; styles 3 mm. long at anthesis; Cascade and Olympic mountains .....10. *S. occidentalis*

Fruits few, ellipsoid, glaucescent, 1–1.5 cm. in diameter at maturity; flowers 10–15 mm. broad; calyx 5–6 mm. long at anthesis; leaflets 7–9, lanceolate to ovate-lanceolate, acuminate, broadest at the base; shrub 1–2 m. tall; Aleutian Islands .....11. *S. sambucifolia*

1. **Sorbus aucuparia** L. Sp. Pl. 477. 1753; Hedlund, Svensk. Vet.-Akad. Handl. **35**: 46. 1901; Schneid. Ill. Handb. Laubholzk. **1**: 672, *f. 371, c-e*, 1906; Britt. & Schafer, N. Am. Trees 428. *f. 374*, 1908; Mathews, Field Book Am. Trees Shrubs 202, *f. opp. p. 202* (as *P. sitchensis*). 1915; Rehder in Bailey, Stand. Cyclop. Hort. **3**: 3195, *f. 3649*. 1917; Bailey, Man. Cult. Pl. 380. 1924; Wiegand & Eames, Fl. Cayuga Basin 246. 1926; Sudworth, Check List 133. 1927; Rehder, Man. Cult. Trees Shrubs 379. 1927; Rosendahl & Butters, Trees Shrubs Minn. 196, *f.* 1928; Schaffner, Field Man. Fl. Ohio 307. 1928; Rydberg, Fl. Prairies Plains 438. 1932; Marie-Victorin, Fl. Laurent. 319, *f. 92*. 1935; Jones, Univ. Washington Publ. Biol. **5**: 180. 1936.

Pyrus Aucuparia Gaertn. Fruct. Semin. Plant. **2**: 45. 1791; Ehrh. Beitr. Naturk. **6**: 94. 1791; Robins. & Fernald in Gray, Manual (ed. 7) 459. 1908; Henry, Fl. S. Brit. Col. 183. 1915; Mathews, Field Book Am. Trees Shrubs 202. 1915.

Aucuparia silvestris Medicus, Geschichte Bot. 86. 1793.

Sorbus subvestita Greene, Pittonia **4**: 131. 1900.

A small tree 6–10 m. tall, with stout, spreading branches; bark grayish, smooth; winter-buds conical, 5–10 mm. long, usually copiously whitish-villous, the pubescence rarely somewhat fulvous; young branchlets more or less pubescent, usually densely so, with grayish or whitish hairs, becoming glabrous in age; leaflets 11–15, oblong, acute, 3–5 cm. long, 1–1.8 cm. wide, somewhat asymmetrical at the base, dull green on the upper surface and more or less pilose when young, pale beneath and usually permanently whitish pubescent; margins coarsely serrate almost to the base, (or in some races to above the middle), the teeth ovate, abruptly mucronate, usually 35–40 on each leaflet, 4–5 per cm.; petioles and rachises whitish-tomentose, at least at flowering time, glandular at the bases of the leaflets; inflorescence 10–18 cm. broad, 75–100-flowered; pedicels and peduncles densely whitish-pubescent (at least in anthesis); flowers 8–9 mm. in diameter; calyx pubescent, the sepals triangular; petals orbicular, sparsely pubescent on the upper surface near the rounded base, 4 mm. long; stamens about as long as the petals; styles

3–4, 1.5–2 mm. long at anthesis, shorter than the stamens; ovary pubescent on top; fruit 9–11 mm. in diameter, scarlet, (glaucescent in herbarium specimens), ripening in August; seeds oval, flattened, light brown, 4 mm. long, 2.5 mm. wide.

TYPE LOCALITY: European.

RANGE: native of Europe; frequently planted for ornament, and becoming naturalized in many places in North America. It has been well established for over half a century from Labrador to Pennsylvania, westward to North Dakota, Washington and southwestern British Columbia.

LABRADOR: Rigolet, July 20, 1921, *Wetmore* (Can). QUEBEC: La Trappe, *Louis-Marie 60* (G). PRINCE EDWARD ISLAND: Brackley Point, *Fernald, Long & St. John 7577* (G, A, Can), *8303* (A, US, NY, Can); Charlottetown, *Fernald & St. John 7576* (A, US, Can). NOVA SCOTIA: Halifax, *Jack 3672* (G, A); Truro, *Jack 622, 631, 3534* (A); Pictou, *Jack 3286* (A). MAINE: Orono, August 22, 1897, *Fernald* (G), *Ricker 404* (US); York, *Bicknell 4986* (NY); Rockland, *Long 966* (NE); Hampden, *Fernald & Long 13758* (NE); Sidney, *Fernald & Long 13757* (NE); Topsham, August 29, 1912, *Furbish* (NE). VERMONT: Brattleboro, May 28, 1912, *Wheeler* (NE). MASSACHUSETTS: Belvidere, *Harris 551* (NE); Indian Ridge, *Pease 1945* (NE); Sherborn, *Loomis 23* (G); Manchester, *Chamberlain* in 1899 (NY); Lexington, April 4, 1917, *Faxon* (A); Swampscott, July 15, 1895, *E. T. & S. A. Harper* (A); Pelham, May 25, 1880, *Minott* (US). CONNECTICUT: Berlin, *Marius Brandegee* (UC). RHODE ISLAND: Wickford, June 17, 1908, *Williams* (G, NE). NEW YORK: Oswego, May 27, 1887, *Coville* (US); Utica, *Haberer 2309* (G). PENNSYLVANIA: Selinsgrove, *Moldenke 2369* (NY). DISTRICT OF COLUMBIA: Washington, June 12, 1892, *Sudworth* (US). ONTARIO: Crystal Beach, June 6, 1926, *Davis* (US); Kingston, September 8, 1900, *Fowler* (US); Snelgrove, *White 5* (G); Hamilton, *Macoun 7841* (Can). MICHIGAN: Marl Lake, September 19, 1915, *Chandler* (US); Williamston, *Yuncker 124* (US). WISCONSIN: Madison, August 24, 1893, *Rock* (US), *Humphrey 89* (US), *Jensen 518* (US). MINNESOTA: St. Louis Co., *Sandberg* in 1890 (isotype of *S. subvestita* Greene, UC); Fort Snelling, September 6, 1891, *Mearns* (G, US); Minneapolis, May 24, 1891, *Burglehaus* (US); Moore Lake, September 5, 1926, *Rydberg* (NY). IOWA: Claremont, *Pammel 46* (US, NY). ILLINOIS: Evanston, *Price* (US); Napeville, May 25, 1898, *Umbach* (US); Jacksonville, May 1886, *Milligan* (US). INDIANA: South Bend, October 1, 1933, *Lyon* (NY, US, A); Laporte, *Deam 9595*

(NY), *17988* (A); Clear Lake, *Deam 26407* (A); Springville, *Deam 7992* (A); Wanatah, October 21, 1924, *Orahood* (NY). MANITOBA: Dropmore, July 1918 and August 1918, *Skinner* (A); Lake Winnipegosis, June 27, 1881, *Macoun* (US, Can). NORTH DAKOTA: Leeds, October 2, 1913, *Lunnell* (US). SOUTH DAKOTA: Brookings, May 25, 1891, *Williams* (US). NEBRASKA: Lincoln, June 10, 1889, *Williams* (US). IDAHO: Hailey, *Woods & Tidestrom 2806* (US). WASHINGTON: Bingen, *Suksdorf 10452* (A); Sequim, May 1915, *Grant* (NY). BRITISH COLUMBIA: Victoria, *Mrs. E. S. Kelley* (CA), *Macoun 79785* (NY, Can). ALASKA: Wrangell, *Coville & Kearney 425* (US), *Eastwood 1010* (A).

Sorbus aucuparia has been a cause of much misunderstanding of the North American species of mountain-ash because specimens of that distinctive European species frequently have been mistaken for the native American *S. decora,* or for intermediates between that species and *S. americana.* It was also the basis for Greene's *S. subvestita.* Likewise, the record of *S. decora* as far west as Manitoba rests on misidentified specimens of *S. aucuparia,* the seeds of which are frequently carried by birds to localities surprisingly remote from human habitations. Complexity is added by the possible fact that *S. aucuparia* L. is a "collective species." Certainly Linnaeus' description of the leaves as "utrinque glabris" does not describe very accurately most of the specimens of the plants that are currently passing as *S. aucuparia.* However, the analysis of the European tree is scarcely within the province of the present study; the problem remains for European botanists to work out. Sterile specimens of *S. aucuparia* often may be identified by the peculiar thickened bases of the lower secondary veins on the back of the leaflet. These appear to be somewhat decurrent along the midvein. Sometimes this condition is not evident at first glance on account of the dense pubescence. Rarely are the leaflets glabrous beneath. The upper surface, usually described as 'pubescent,' in most instances quickly becomes glabrous as in the native species.

Several horticultural varieties of this well known species have been described from European material and many of them are cultivated in American gardens. These are briefly characterized in Rehder's Manual of Cultivated Trees & Shrubs. Hybrids between *S. aucuparia* and *S. americana* are sometimes cultivated. These are known by the name *S. splendida* Hedl. The only example that I have seen of what may be a natural hybrid between *S. aucuparia* and a native species is a collection that appears to represent *S. aucuparia* × *S. decora.* A fruiting specimen (*Macoun 21714*) collected August 11, 1900 near Opeongo Lake, Algon-

quin Park, Ontario, seems to be intermediate in many respects between the two species. The fruits, as well as the pubescence of the buds and the underside of the leaflets, resemble those of the first species, while the shape, serration, and venation of the leaflets are more like those of *S. decora*. The later time of flowering of *S. decora,* and its montane habitat, no doubt prevent frequent crossings of this species with *S. aucuparia.** Sometimes specimens of *S. aucuparia* are confused with *S. decora,* but the densely pubescent buds of the former, as well as the pubescence of the pedicels and the lower leaf surface, and its larger fruits are fairly reliable differentiating characters. In addition, the shape and serration of the leaflets, and the size and shape of the seeds are distinctive. Even on specimens lacking fruits, flowers, or leaves, the densely-whitish pubescent winter buds will usually serve to identify *S. aucuparia* immediately.

There are two natural intergeneric hybrids with different species of *Aronia* reported from eastern North America. These are: *S. aucuparia* × *Aronia arbutifolia* (L.f.) Elliot = *Sorbaronia hybrida* (Moench) Schneid. with the lower surface of the leaflets densely grayish pubescent, and the upper surface lacking any black glands along the midvein, represented by the following specimen: Truro, N. S., *Jack 3267* (US); the other is: *S. aucuparia* × *Aronia melanocarpa* (Michx.) Britt. = *Sorbaronia fallax* Schneid. with the lower surface of the leaves sparingly pilose to glabrous, and the upper surface often with a few black glands along the midvein toward the base of the leaf. The following Gray Herbarium specimens from Massachusetts apparently represent this hybrid: Andover, *Pease 727, 1058, 3146;* East Holliston, July 1909, and May 13, 1910, *Loomis;* Ipswich, May 26, 1908, *Alcott;* also Bangor, Maine, June 9, 1905, *Knight.*

The binomial *Pyrus aucuparia* was published by both Gaertner and Ehrhart in 1791, but if we accept the dates on the prefaces of their two works to decide the question of priority, Gaertner's name is sixteen days earlier, because his preface is dated April 6, while the date on Ehrhart's is April 22. In his list of synonyms, however, Ehrhart cited Ehrh. Plantag. 20, which refers to an earlier work, namely "Verzeichniss der Bäume und Sträuche, welche sich auf der Königl. Plantage zu Herrenhausen bei Hannover befinden." This was published anonymously by Ehrhart in 1787, and consists of a bare list of names.†

It will be noted that, contrary to custom, the specific name of this species is decapitalized. This is done because it appears that Linnaeus

*See Dobzhansky, Genetics and the Origin of Species, 1937. Chapter 8, on isolating mechanisms.

†For a note on this obscure publication see p. 137.

was using the word in an adjectival sense rather than as a noun based on the generic name *Aucuparia* of Rivinus. This is indicated by the fact that he used a small initial.

2. **Sorbus dumosa** Greene, Pittonia **4**: 129. 1900; Hedlund, Svenska Vet.-Akad. Handl. **35**: 138. 1901; Rehder, Man. Cult. Trees Shrubs 378. 1927.

A shrub 2–3 m. tall, with slender, clustered stems; bark reddish; winter-buds densely whitish villous; young twigs densely whitish pubescent; lenticels few, small, inconspicuous, narrowly oval; leaves small, 6–15 cm. long; leaflets 9–11, rarely 13, thin, 2–4 cm. long, 1–1.5 cm. wide, oblong-lanceolate to oval, evenly serrate from the apex almost to the base, the teeth sharp, pointing forward, somewhat gland-tipped; apex sharply acute, the base rounded or cuneate, more or less oblique; upper surface dark green, somewhat glossy, glabrous; lower surface pale green, finely reticulate, glabrous except sometimes a few pilose trichomes along the midvein; petioles and rachises copiously pilose-pubescent or puberulent; inflorescence small, narrow, compact, round-topped, 3–7 cm. broad, 40–60-flowered; pedicels and peduncles densely villous with whitish hairs; calyx densely pubescent, 3 mm. long, the sepals broadly triangular, sharply acute, non-glandular, 1.5 mm. long, more or less ciliolate on the margins; petals about as long as the stamens, oval, cuneate at the base, 3–4 mm. long; styles 4, 2–2.5 mm. long, shorter than the stamens; anthers 1 mm. long; top of the ovary pubescent; fruit red, glossy, ellipsoid to subglobose, 6–8 mm. in diameter; seeds lanceoloid, light brown, 3–3.5 mm. long, 1.5–2 mm. wide.

TYPE LOCALITY: San Francisco Mountains, Arizona. Collected by Greene in 1889.

RANGE: A rather local subalpine species of Arizona and New Mexico.

ARIZONA: Mt. Lemmon, *Shreve 5301* (A, G); Chiricahua Mts., July 1927, *Kusche* (A); Greenland Point, *M. E. Jones 6056f* (US); Baker Butte, *Coville 1048* (US); Elden, September 30, 1910, *Percival Lowell* (A); North River, Grand Canyon Nat. Park, *U. S. Park Service no. 2000* (US); Sabina Canyon, August 4, 1906, *Holmes* (US); Mt. Thomas, *Goldman 2473* (US); White Mts., *Coville 2010* (US), *Goodding 1202* (US, NY), *Peebles & Smith 12516* (US); Kendrick Peak, June 22, 1911, *Percival Lowell* (A), *Purpus 8003* (A, US, UC), *Leiberg 5657* (US), *Goldman 2108* (US); San Francisco Mts., July 7, 1891, *MacDougal 330* (A, US), *Leiberg 5713* (US), *D. E. Palmer* in 1869 (US); Santa Catalina Mts., *Lemmon 183* (UC), *J. A. Harris C16448* (NY), *Livingston & Thornber* in 1906 (NY), *Peebles & Harrison*

2262 (US). New Mexico: Pecos River National Forest, *Standley 4446* (NY, US); Manzano Mts., *V. Bailey 1426* (US); Zuni Mts., *Goldman 1591, 1602* (US); Tunicha Mts., *Standley 7733* (US, NY).

This is a relatively little known and rather obscure species of limited distribution in the mountains of Arizona and New Mexico. It is not closely similar to any other species, but evidently belongs to the *americana-scopulina* group, as is shown by the whitish pubescence and the acute leaflets. Geographically, and probably phylogenetically, it comes closest to *S. scopulina* Greene, but it differs considerably from that species, as is indicated by an examination of a photograph of the holotype, several topotypes, and a fairly good series of other specimens, in being a more slender shrub with fewer and smaller leaflets, a smaller, fewer-flowered, round-topped inflorescence, and a characteristic dense, whitish pilose pubescence or puberulence of the winter-buds, rachises, and pedicels. There seems to be a tendency for the stipules to be persistent.

3. **Sorbus americana** Marsh. Arbust. Am. 145. 1785; Willd. Enum. Pl. **1**: 520. 1809; Schneider, Ill. Handb. Laubholzk. **1**: 677, *f. 371, h-i, 372, g.* 1906; Hough, Handb. Trees N. U. S. Canada 239, *f. 277–279.* 1907; Britt. & Schafer, N. Am. Trees 427, *f. 373.* 1908; Britt. in Britt. & Brown, Ill. Fl. N. States (ed. 2) **2**: 287, *f. 2318.* 1913; Mathews, Field Book Am. Trees Shrubs 201, *f. opp. p. 202.* 1915; Rehder in Bailey, Stand. Cyclop. Hort. 3195, *f. 3648.* 1917; Sargent, Man. Trees N. Am. (ed. 2) 390, *f. 347.* 1922; Bailey, Man. Cult. Pl. 380, 1924; Pease, Vasc. Pl. Coos Co., N. H., 266. 1924; House, N. Y. State Mus. Bull. **254**: 408. 1924; Wiegand & Eames, Fl. Cayuga Lake Basin 246. 1926; Sudworth, Check List 133. 1927; Rehder, Man. Cult. Trees Shrubs 377. 1927; Rosendahl & Butters, Trees Shrubs Minn. 194, *f.* 1928; Miller & Tehon, Div. Nat. Hist. Surv. Illinois Bull. **18**: 202, *pl. 65.* 1929; Rydberg, Fl. Prairies Plains 438, 1932; Small, Man. SE. Fl. 632, *f.* 1933; Coker & Totten, Trees SE. States, 190, *f.* 1934; Marie-Victorin, Fl. Laurent. 319, *f. 92.* 1935.

Sorbus Aucuparia var. α Michx. Fl. Bor. Am. **1**: 290. 1803.

Sorbus micrantha Dum.-Cours. Bot. Cult. (ed. 2) **5**: 464. 1811.

Sorbus microcarpa Pursh, Fl. Amer. Sept. **1**: 341. 1814; Roemer, Syn. Mon. 138. 1847; Hedlund, Svenska Vet.-Akad. Handl. **35**: 41, *f. 7g.* 1901.

Sorbus aucuparia sensu Bigelow, Flora Boston. 119. 1814.

Pyrus microcarpa DC. Prodr. **2**: 636. 1825; Spreng. Syst. **2**: 511. 1825.

Pyrus americana DC. β *microcarpa* Torrey & Gray, Fl. N. Am. **1**: 472. 1843; Nutt. N. Am. Sylva **2**: 25, 27. 1853.

Sorbus americana Marsh. var. *microcarpa* Wenzig, Linnaea 38: 73. 1874; Rehder in Bailey, Stand. Cyclop. Hort. 3194. 1917.

Aucuparia americana Nieuwl. Am. Midl. Nat. 4: 175. 1915.

Pyrus americana sensu Watson & Coulter in Gray, Man. (ed. 6) 164. 1889; Sargent, Silva N. Am. 4: 79, *pl. clxxi, clxxii.* 1892; Chapman, Fl. SE. U. S. (ed. 3) 141. 1897; Dame & Brooks, Handb. Trees New Engl. 112, *pl. lvii.* 1902; Robins. & Fernald, in Gray, Man. (ed. 7). 459. 1908; Mathews, Field Book Am. Trees Shrubs 201, *f. opp. p. 202.* 1915; St. John, Bot. Expl. Gulf St. Lawrence 91, 1922. Non DC., 1825.

A small tree (or shrub) 4–10 m. tall, the trunk with a maximum diameter of 20–30 cm; branches slender, ascending or spreading; bark nearly smooth, gray, with some small irregular scales; winter-buds conical, glabrous or nearly so, 1–2 cm. long, glutinous; young branchlets glabrous or sparingly pilose, reddish brown, with numerous elongate lenticels; leaflets 11–17, lanceolate to narrowly oblong-lanceolate, acuminate, 5–9 cm. long, 1–2.5 cm. wide, 3½–5 times as long as wide, the base cuneate or rounded, somewhat asymmetrical; margins sharply and finely serrate nearly to the base with lanceolate, acuminate, incurved teeth, or sometimes slightly double-serrate; upper surface bright green and glabrous; lower surface paler, usually becoming completely glabrous at maturity; terminal leaflet oval; petioles and rachises glabrous, except for several glands and frequently a few long trichomes at the bases of the leaflets; inflorescence flat-topped, 6–15 cm. broad, densely 125–200-flowered; pedicels and peduncles essentially glabrous; bracts caducous; flowers about 5–6 mm. in diameter; petals oval, 3–4 mm. long, cuneate at the base; sepals triangular, acute, 1 mm. long, sometimes with minute dark sessile marginal glands; stamens 15–20, shorter than the petals; ovary pubescent on top; styles 3, equalling or only slightly shorter than the stamens, 2 mm. long; fruit 4–6 mm. in diameter, globose, bright red, glossy, acid, ripening in August; seeds lanceoloid, asymmetrical, chestnut brown, 3 mm. long, 2 mm. wide.

TYPE LOCALITY: Northeastern North America, probably Pennsylvania. "This grows naturally upon the mountains towards Canada." (Marshall, l. c.)

RANGE: Newfoundland to northeastern Minnesota, southward across northern Illinois to eastern Tennessee and North Carolina.

NEWFOUNDLAND: Grand Falls, *Fernald & Wiegand 5660* (G), *5657* (G, A, Can, NY); Frenchman's Cove, *Mackenzie & Griscom 10322* (G); Bonne Bay, *Kimball 106* (G); Channel, *Howe & Lang 976* (G); Conception Bay, *Howe & Lang 1202* (NY); Miller Junction, *Fernald & Wiegand 5658* (G); Glenwood, *Fernald & Wiegand 5659* (G); St.

Johns, July 16, 1902, *Dame* (G); Cow Head, *Fernald & Wiegand 3550* (G); Bay of Islands, July 21, 1902, *Dame* (A); Brig Bay, *Fernald et al. 28490* (G, A). QUEBEC: Harbour Island, *Abbe 1239* (G); Lac Tremblant, July 21, 1922, *Churchill* (G); Ascot, July 29, 1923, *Chamberlain & Knowlton* (G); Black Lake, *Fernald & Jackson 12105* (G); Riviere Romaine, *Marie-Victorin & Rolland-Germain 20906* (G); Romaine, July 8, 1915, *St. John* (G, Can); Gaspé Bay, August 23, 1897, *Jack* (A); Lake St. John, August 22, 1895, *Jack* (A); Lac des Roches, *Marie-Victorin 5516* (A); Anticosti Isl., *Marie-Victorin & Rolland-Germain 27369* (A, G); Gatineau River, *Macoun 4574* (NY); Calumet, *Macoun 8189* (Can). PRINCE EDWARD ISLAND: Charlottetown, *Fernald & St. John 7573* (A, Can, US). NEW BRUNSWICK: Fredericton, *Jack 596* (A); Campobello Isl., *J. D. Smith* in 1888 (US). NOVA SCOTIA: Clementsport, *Jack 3700* (A, G); Sissiboo River, *Fernald et al. 21426* (G); Barasois River, Cape Breton Isl., *Nichols 1178* (G); Baddeck, *Macoun 19085* (G, Can); Folly Lake, September 29, 1917, *Jack* (A); Halifax, *Jack 674, 3240* (A), *Howe & Lang 1472* (G, NY); Salmon Lake, *Fernald, Long & Linder 21428* (A, Can, G); Barton, *Jack 3342* (A); Bedford, July 3, 1883, *Macoun* (Can), *Jack 3320* (A); Pleasant Valley *Jack 3163* (A); Fall River, *Jack 3314* (A); Yarmouth, *Jack 3872* (A); Shelburne, *Jack 3459* (A); Digby, *Howe & Lang 250* (NY); Springville, *C. B. Robinson 505* (NY). MAINE: St. Francis River, August 12, 1902, *Eggleston & Fernald* (A, G, NE); Mt. Desert, June 27, 1890, *Redfield* (US); Pleasant Pond, August 18, 1902, *Collins & Chamberlain* (G, NE); Monhegan Isl., August 29, 1901, *Churchill* (G); *Jenney, Church & Hill 3159* (NE); Grand Isle, *Fernald 2304* (NE); Mount Katahdin, July 14, 1900, *Fernald* (NE); Mount Kineo, *Cushman 1925* (NE); St. John Pond, *St. John & Nichols 2331* (NY, NE); Brooklin, *Hill 571* (NE); Duck Harbor, *Hill 1737* (NE); South Poland, *Furbish* in 1893 (NE); Orono, *Briggs* in 1893 (NY). NEW HAMPSHIRE: Randolph, *Pease 18085* (NE); Pittsburgh, *Pease 10829* (NE); Mount Washington, *Jack 2478* (A); Jaffrey, *Robinson 624* (G, NE); Rindge, *Batchelder* in 1913 (NY); East Hebron, July 18, 1917, *Wilson* (NY). VERMONT: Chittenden, *Eggleston 195* (US, G); Mt. Mansfield, August 6, 1902, *Rehder* (A); Long Pond, June 11, 1895, *Westmore* (G); Willoughby, June 16, 1898, *Williams* (G); Woodford, June 20, 1925, *Carpenter, Churchill & Knowlton* (NE); Middlebury, June 13, 1879, *Brainerd* (NY). MASSACHUSETTS: Princeton, *Pease 724* (NE); Ashburnham, August 8, 1908, *Knowlton* (NE); Williamstown, September 8, 1897, *Churchill* (NE); Worthington, *Robinson 670* (G); Mount Watatic, Ashby, August 9, 1908, *Knowlton* (G). CONNECTICUT: Dur-

ham, *Blewitt 1775* (NE); Meriden, July 20, 1913, *Bissell* (NE); Winsted, July 5, 1912, *Blewitt* (NE); North Canaan, *Blewitt 665* (NE). NEW YORK: Black Bear Mountain, *Killip 7143* (A, US), *31783* (A); Lake Placid, August 9, 1902, *Rehder* (A); Lake George, July 31, 1900, *Burnham* (G); Long Lake, *House 10217* (G); Plymouth, *Wiegand 6581* (G); Colton, *Phelps 1411* (NY, G); Rome, *Muenscher 14768* (G); Olean, *Muenscher 15584* (G); Hunter Mountain, *Muenscher et al. 15566* (G); Turnwood, August 12, 1891, *Rusby* (NY); Slide Mt., May 31, 1901, *Britton* (NY); Catskill Mts., *Britton* in 1898 (NY). NEW JERSEY: High Point, *Mackenzie 4652* (G, NY); Mt. Hope, *Tompkins* (NY). PENNSYLVANIA: Lenhartsville, *Long 12894* (G); Pocono Plateau, August 1904, *Harshberger* (G), *Small* in 1889 (NY); Bangor, September 5, 1908, *Bartram* (A); Port Allegheny, September 7, 1928, *Gable* (A); Laporte, *Eggleston 22696* (US). MARYLAND: Garrett Co., June 28, 1882, *J. D. Smith* (US); Oakland, *Tidestrom 6436* (US). WEST VIRGINIA: Panther Mountain, *Rydberg 9028* (A, NY); Aurora, August 18, 1898, *Steele* (A, NY, US); Cheat Valley, August 27, 1907, *Rehder* (A); Stony River Dam, *Core 6776* (NY, G); mont. Virg. Carol. Sept., July 1841, *Gray & Carey* (G, US); Spruce Knob, *Rydberg 9185* (NY), *Greenman 148* (G), *Millspaugh 1624* (NY). VIRGINIA: Peaks of Otter, September 1, 1871, *Curtiss* (G), *Eggleston 18636* (US); Stony Man Peak, *Steele 136* (G, US, NY); Crescent Rocks, *Camp 1260* (NY). NORTH CAROLINA: Grandfather Mountain, *Randolph 1191* (G), *Small & Heller 298* (US, NY), *Rydberg 9348* (NY), *Curtis* (NY, the type of *Pyrus americana β microcarpa* Torr. & Gray); Craggy Mountain, *Biltmore Herbarium 486* (G, A, US, NY); Roan Mountain, September 24, and September 27, 1885, *Sargent* (A); Highlands, *Harbison 80* (A). TENNESSEE: New Found Gap, June 27, 1931, *Jennison* (US). MICHIGAN: Emerson, *Dodge 15* (A); Pellston, *Gates 14883* (A); Turin in 1901, *Barlow* (A, NY); Vermillion, *Dodge 12* (A). ILLINOIS: Oregon, June 6, 1888, *Waite* (US). WISCONSIN: Newbold, *Palmer 28692* (US, A); Rhinelander, *Palmer 28703* (A, US); Wheeler, *Palmer 28561* (A); Kilbourn, *Palmer 28415* (A); Star Lake, September 1901, *Denniston & Timberlake* (G); Antigo, August 1898, *Cheney* (G); Sturgeon Bay, July 11, 1885, *Schuette* (G); Newport, June 24, 1883, *Schuette* (NY). MINNESOTA: Duluth, September 16, 1882, *Faxon* (A); Vermillion Lake, *Arthur, Bailey & Holway B315* (G); Grand Marais, *Rydberg 9612* (NY), *Butters & Buell 477* (G, US, NY); Mineral Center, *Rosendahl & Butters 4583* (G, NY); Crab Lake, *Butters* in 1918 (NY).

Sorbus americana is apparently the commonest eastern North American species. The flowering period is May and June. Fruits are ripe in

late August and September, persisting into the winter. It is abundant in rich rather moist soil along the borders of swamps, and on rocky hillsides. It grows also along riverbanks, and in cool mountain woods. In the autumn the tree is very attractive on account of the conspicuous yellowish leaves and red fruits. This species can be distinguished from *S. decora,* which has a similar range, and with which there has been some confusion in the past, by its smaller flowers with the stamens shorter than the petals, the smaller fruits and seeds, and by the narrow, linear-lanceolate to lanceolate, acuminate, finely toothed, usually glabrous leaflets. Hybrids between *S. americana* and *Aronia melanocarpa* are known in cultivation, although I have seen no specimens of spontaneous American plants. If a hybrid-genus name is used it would be written × *Sorbaronia sorbifolia* (Poir.) Schneid. In this issue of the Journal of the Arnold Arboretum, p. 95, Professor Rehder describes a hybrid between *Sorbus americana* and *Aronia prunifolia.*

The nomenclatural history of this species, and of the somewhat distantly related *S. decora,* is rather complex. As previously noted, *S. americana* was first described by Marshall in 1785. André Michaux in 1803, overlooking or ignoring Marshall's work, characterized the two native northeastern American mountain ashes as varieties α and β of *S. aucuparia* L. The variety α was said to have "foliis acuminatis," and habitat "in excelsis montibus Carolinae." This is obviously *S. americana* Marsh. The var. β was characterized by "foliis sensim acutis," and the habitat "in Canada et circa lacum Ontario." Plainly, this is the northern shrub we now call *S. decora.* In 1809 Willdenow published as a new species *S. americana,* citing "*S. aucuparia* Mich." as a synonym and giving the habitat "in montibus excelsis Carolinae," evidently quoting from Michaux. In doing this possibly he was unaware of the earlier publication of *S. americana* Marsh., or at any rate he did not refer to it. The var. α and var. β of Michaux were evidently regarded as identical, and in combining them he selected the var. α as the principal element, as is indicated by his statement of habitat. From the description "S. foliis pinnatis, foliolis subaequaliter serratis petioloque communi glaberrimus" there is nothing more to be learned about the character of the specimens he may have had in hand, since the statement will apply equally to almost any species of *Sorbus,* and the supplementary remark "Baccae purpureae nec coccineae" is an attempt to contrast the color of the fruits with that of *S. aucuparia.* So far, then, the case is clear: *S. americana* Willd. 1809 = *S. Aucuparia* Var. α Michx. 1803 = *S. americana* Marsh. 1785. Pursh in 1814 was the first to recognize the fact that there are two distinct species native to northeastern North

America, each entirely different from the other and from the European *S. aucuparia* L. The northern plant with acute leaflets and large fruits Pursh called *S. americana,* citing Willd. Enum. Plant. 520, from where he copied the description. To this description, however, he made the important addition "foliolis acutis," citing *S. Aucuparia* var. *β* Michx. as a synonym, and giving the habitat "In Canada and on some of the northern mountains." All this refers unmistakably, of course, to *S. decora* (Sarg.) Schneid., and confirms the fact that *S. americana* Pursh is not *S. americana* Marsh. It is interesting to notice that Pursh has copied from Willdenow the statement "Berries purple, not scarlet as in the European species." Pursh designates the other native eastern North American shrub (the one with acuminate leaflets, small fruits, and a more southerly range), by the new name *S. microcarpa.* He cites *S. Aucuparia α* Michx. as a synonym, gives the habitat and range "On the peaks of high mountains: New Jersey to Carolina," and adds the comment "This species is very distinct from the Canadian *Sorbus.*" i.e., his *americana,* which, as previously pointed out, is *S. decora* (Sarg.) Schneid., but not *S. americana* Marsh. In 1825 A. P. De Candolle transferred these species to *Pyrus,* but unfortunately the name *Pyrus americana* DC., designating the northern shrub with acute leaflets and large fruits, is based upon *Sorbus americana* Pursh, and therefore is not synonymous with *S. americana* Marsh.

Hedlund (l. c.) rejects the name *Sorbus americana* Marsh. as a nomen dubium and accepts instead *S. microcarpa* of Pursh. While Marshall's description is not as definite as might be desired, nevertheless there seems to be no compelling reason for upsetting the usage of more than a century and a half in order to adopt a name that is only slightly less vague in its exact application. In any event the name *S. microcarpa* is three years later than *S. micrantha* of Dumont de Courset. There is scarcely any doubt as to the identity of Marshall's species since it is the only native feral *Sorbus* occurring in Pennsylvania, where Marshall had his garden, and from where, presumably, he secured his specimens.

Perhaps it would not be out of place to parenthetically note the fact that many of the references in Sargent's Silva (l. c.) under *Pyrus americana* really belong to *S. decora.*

4. **Sorbus scopulina** Greene, Pittonia **4:** 130. 1900; Hedlund, Svenska Vet.-Akad. Handl. **35:** 138. 1901; Rydberg, Fl. Colorado 193. 1906; Schneider, Ill. Handb. Laubholzk. **1:** 677, *fig. 372 c-f.* 1906; Coulter & Nelson, New Man. Rocky Mt. Bot. 269. 1909; Wooton & Standley, Contr. U. S. Nat. Herb. **19:** 324. 1915; Ryd-

berg, Fl. Rocky Mts. 448. 1917; Tidestrom, Contr. U. S. Nat. Herb. **25**: 284. 1925; Kirkwood, N. Rocky Mt. Trees Shrubs 197, *f. 40, pl. 25*. 1930; Rydberg, Fl. Prairies Plains 438, *f. 291*. 1932; Graham, Ann. Carnegie Mus. **26**: 244. 1937.

Pyrus americana sensu Cooper, Am. Nat. **3**: 406. 1870. Non DC., 1825.

Pyrus sambucifolia sensu Watson in U. S. Geol. Explor. **5**: 92. 1871; Porter & Coulter, Syn. Fl. Colorado 48. 1874; Coulter, Man. Bot. Rocky Mt. Region 89. 1885. Non Cham. & Schlecht., 1827.

Sorbus sambucifolia sensu Rydberg, Contr. U. S. Nat. Herb. **3**: 498. 1896, Mem. N. Y. Bot. Gard. **1**: 227. 1900; Standley, Contr. U. S. Nat. Herb. **22**: 366. 1921. Non Roemer, 1847.

Pyrus sitchensis Piper, Contr. U. S. Nat. Herb. **11**: 347. 1906, ex parte; Piper & Beattie, Fl. SE. Wash. Adj. Idaho 134. 1914.

Sorbus angustifolia Rydberg, Fl. Rocky Mts. 448. 1917; Rehder, Man. Cult. Trees Shrubs 377. 1927. *Synon. nov.*

Sorbus sitchensis var. *densa* Jepson, Man. Fl. Pl. Calif. 508. 1925.

Pyrus scopulina Longyear, Trees Shrubs Rocky Mt. Reg. 152. 1927.

Sorbus dumosa sensu Raup, Contr. Arnold Arb. **6**: 174. 1934. Non Greene, 1900.

Sorbus sitchensis sensu Raup, Jour. Arnold Arb. **17**: 264. 1936. Non Roemer, 1847.

Pyrus dumosa sensu St. John, Fl. SE. Wash. Adj. Idaho 205. 1937. Non Fernald, 1921.

A shrub 1–4 m. tall, sometimes forming dense clumps; bark thick, reddish; winter-buds glossy, glutinous, the scales brown, glabrous or sparsely whitish-pilose dorsally, ciliate on the margins; young twigs sparingly pilose; stipules membranous, glabrous; leaflets 11–13, the lateral lanceolate or oblong-lanceolate, 3–6 cm. long, 1.2–2 cm. wide, 3–5 times as long as wide, cuneate at the base and slightly oblique, sharply acute or shortly acuminate at the apex, the margins finely and sharply simply or doubly serrate from the apex almost to the base, the teeth ovate-lanceolate, sharply acuminate, not at all glandular or callose at the tips; glabrous on both surfaces at least when mature, the upper surface dark green and glossy, perfectly glabrous, reticulate-rugose when fresh, paler beneath; terminal leaflet oval; petioles and rachises glabrous or nearly so, except for a few glands and several long trichomes at the bases of the leaflets; inflorescence dense, flat-topped, 9–15 cm. broad, 80–200-flowered; pedicels and peduncles sparingly pilose; flowers fragrant, about 1 cm. in diameter; calyx pilose, the sepals triangular, acute, 1.5 mm. long; petals oval, 5–6 mm. long, about as long as the stamens; styles 3–4, 2–2.5 mm. long, about half the length of the stamens; top of the ovary pubescent; fruit orange or scarlet, glossy, not glaucescent, globose, 8–10 mm. in diameter, bitter; seeds oblong, almost symmetrical, light brown, 3.5–4 mm. long, 1.5–2 mm. wide.

TYPE LOCALITY: Near Pagosa Peak, altitude 9000 feet, Colorado. Collected by C. F. Baker, August 10, 1899.

RANGE: British Columbia and Alberta to South Dakota, eastern Washington and southward to New Mexico.

BRITISH COLUMBIA: Cariboo, *Macoun 8215* (Can); Yale, *Macoun 8209* (Can); Yellowhead Pass, *Macoun 19335* (Can); Chilliwack Lake, *Spreadborough 79775* (Can); Moose Pass, *Hollister 47* (US); Donald, July 18, 1887, *Macoun* (NY); Glacier, August 12, 1897, *Sargent* (A), *Brown 256* (US, NY), *Snyder 545* (US, NY), *Butters & Holway 727* (G); Emerald Lake, *Shaw 69* (US, NY), *Shaw 1114* (G, NY, US), *Peterson 132* (US, NY); Revelstoke, *Shaw 813* (US, NY, G); Rocky Mt. Canyon, *Raup & Abbe 3750* (A, Can); Stikine River, July 10, 1919, *Swarth* (UC); Lake Atlin, September 7, 1930, *Setchell & Parks* (UC); Waldie Creek, *MacFadden 13892* (UC); Klappan River, *Preble & Mixter 655* (US). ALBERTA: Assineau River, *Brinkman 4395* (NY); Atauwau River, *Brinkman 4181* (NY); Vermilion Mt., *McCalla 2099* (US, NY), August 1899, *Sanson* (CA, Can); Lake Athabaska, *Raup 4470, 4584, 4659* (G); Little Slave Lake, *Macoun 1574* (Can); Kicking Horse Pass, *Macoun 1575a* (Can). SASKATCHEWAN: Lake Athabaska, *Raup 6425, 6799, 6930* (G), *Laing 210* (US). SOUTH DAKOTA: Deadwood, *Hayward 247* (NY), *Palmer 37611* (A, NY); Strawberry Gulch, *Murdoch 3090* (G, NY); Lawrence Co., *Over 13687* (US); Watertown, *Over 15917* (A). MONTANA: Bridger Mts., *Flodman 546* (NY, US), *Rydberg & Bessey 4427* (G, NY, US), June 27, 1901, *W. W. Jones* (A, US, UC), *Blankinship 159* (US); Neihart, *Williams 851* (US); Sinyaleamin Lake, *MacDougal 328* (NY, US); Midvale, *Umbach 96* (NY, US); Two Medicine Lake, *Standley 15027* (US); Glacier Park Station, *Standley 17706* (US); Belton, *Standley 18641, 18642* (US), *Jack 1607* (A); Many Glacier, August 25, 1921, *Susan D. McKelvey* (A), *Jack 2003* (A); Lake McDonald, *Jack 2338* (A), September 16, 1921, *Susan D. McKelvey* (A), July 16, 1909, *M. E. Jones* (NY); Gunsight Lake, *Jack 2244* (A); Grant Creek, *Kirkwood 31* (A); Marshall Gulch, *Kirkwood 31a* (A); MacDougal Peak, July 30, 1908, *Mrs. J. Clemens* (G, A), *M. E. Jones 8141* (US); Flathead Lake, August 10, 1908, *Mrs. J. Clemens* (G, A); Avalanche Lake, July 17, 1896, *Sargent* (A), *Jack 2292* (A); Logan Pass, *C. L. Hitchcock 1944* (G); St. Mary, *Jack 1522* (A); St. Mary Lake, *Standley 17070* (US); Livingston, September 20, 1892, *Kelsey* (NY); Helena, *Kelsey* (UC); Columbia Falls in 1894, *Williams* (G, NY); Bozeman, June 26, 1900, *Blankinship* (UC). IDAHO: Cedar [Moscow] Mt., *Sandberg, MacDougal & Heller 421* (G, US, NY),

Elmer 350 (US, NY, A), August 1896, *Elmer* (A), *Abrams 664* (UC, NY, A), *Jack 1265* (A), *Henderson 2688* (G, US), *Eggleston & St. John 21984* (US), July 1898, *Piper 1527* (TYPE of *S. angustifolia* Rydb., NY; ISOTYPE, G); Bohannan Creek, *Henderson 4037* (US); Wiessners Peak, *Leiberg 1381* (US); Alturas Lake, *Evermann 497* (US); Bascom's Ranch, Elmore Co., *Macbride 629* (G, NY, US, UC); Silver City, *Macbride 1013* (NY, US, UC, G); Pinehurst, *Macbride 1677* (US, G, UC); Beaver Canyon, *Shear 3131* (US, NY); Seven Devils Mts., August 5, 1899, *M. E. Jones* (NY); Quartzburg, July 24, 1892, *Mulford* (NY, A); St. Maries, *House 4921* (US); Sohons Pass, *Leiberg 1381* (G, NY, A, UC); Hope, *Munson & Hopkins* in 1889 (US); Little Skeleton Creek, *Woods & Tidestrom 2572* (US); divide between St. Joe & Clearwater rivers, *Leiberg 1194* (NY, A, UC, US); Kootenai Co., *Sandberg 4326* (NY); Little Dry Creek Canyon, *Rust 675* (CA); Elk Butte, *Jack 1333* (A); Elk River, *Jack 1300* (A); Lake Waha, *Heller 3275* (NY, US, A, UC); Priest Lake, July 28, 1896, *Sargent* (A), *MacDougal 154* (NY); Pend Oreille River, *D. Lyall* in 1860 (G). WYOMING: Copperton, *Tweedy 4182* (US, NY); Leighs Lake, *Merrill & Wilcox 987* (US); Piney Creek, August 28, 1900, *Jack* (A); Hidden Falls, *Williams 866* (NY, CA); South Spring Creek, *Eggleston 11290* (US); Centennial, *Nelson 10114* (UC); Lander, *Nelson & Nelson 360* (UC); Battle Lake, *Nelson & Nelson 350* (NY, G, UC); Teton Pass, *Merrill & Wilcox 981* (G, NY); Bighorn Mts., *Tweedy 2538* (NY); Teton Mts., *Nelson 982* (NY, G, US); Green River, October 1870, *Hayden* (G, NY); Elk Mountain, Carbon Co., *Goodding 553* (A, G, US, UC, NY); Gros Ventri River, *Tweedy 198* (NY); *Yellowstone National Park*: Firehole River, September 3, 1904, *Rehder* (A); Yellowstone Lake, July 20, 1902, *Scheuber* (US), *A. Nelson & E. Nelson 6333* (US, G, NY); Mammoth Hot Springs, *Mearns 4602* (US, NY); 12 miles east of Old Faithful, *Maguire 1177* (UC); without definite locality, *Mearns 4238* (G, US). UTAH: east of Gunnison, *Ward 668* (G, US); Peterson, *Pammel & Blackwood 3819* (G, A); Sierra la Sal, *Purpus 7039* (US, UC); Mt. Timpanogos, *Maguire 3648* (UC); Timpanogos Canyon, *Palmer 38092* (A); Mt. Nebo, *Rydberg & Carlton 7576* (US, NY); Mt. Pleasant, *Tidestrom 1868* (US); Salt Lake, *Eastwood 7748* (A, CA); Wasatch Mts., *Watson 351* (US, G, NY); Immigration Gap, *House 5045* (NY); Provo, *M. E. Jones 5583* (US, UC, NY, A), *Goodding 1153* (US, G, UC, NY); Ogden, *A. S. Hitchcock 1449* (US); Logan, August 9, 1895, *Rydberg* (NY), *Shear 3173* (NY); American Fork Canyon, *M. E. Jones 1369* (A, NY); East Bountiful, September 22, 1909, *Mrs. J. Clemens* (CA, NY); Red Butte,

June 9, 1908, *Mrs. J. Clemens* (A); Big Cottonwood Canyon, *Rydberg & Carlton 6611* (G, NY), *Garrett 1346* (G). COLORADO: Pagosa Peak, *Baker 403* (A, G, US TYPE, UC, NY); Columbine, *Cary 77* (US); Rabbit Ear Range, *Goodding 1578* (A, US, G, UC, NY); Rabbit Ear Pass, *Nelson & Nelson 340* (UC); Telluride, *Tweedy 221* (US); Tolland, *Palmer 31401* (A); Mt. Carbon, *Eggleston 5737, 6184* (US), *Tidestrom 3809, 4060* (US); Victoria, *Tweedy 4181* (US, NY); Elk Mts., *Brandegee* in 1881 (UC); Minnehaha, *Johnston 2547* (UC); Wolf Creek Pass, *Eggleston 20540* (NY), *Wolf 3068* (G, CA), *Susan D. McKelvey 4727* (A); Dry Creek, Uncompahgre Nat. Forest, *Tidestrom 1543* (US); Uncompahgre Plateau, *Maguire 12821* (UC); Buffalo Pass, *Shear & Bessey 3937* (NY); Four Mile Hill, Routt Co., July 22, 1896, *Baker* (NY); Sierra La Plata, *Brandegee 1148* (UC); Empire, *Tweedy 5762* (NY); Palmer Lake, August 12, 1896, *Crandall* (NY); Douglas Creek, *Graham 9697* (US); Upper La Plata Canyon, *Baker, Earle & Tracy 653* (A, G, US, NY); Granite Peaks, *Susan D. McKelvey 4688* (A); Ouray, *Baker 757* (NY, G, US), *Underwood & Selby 107* (NY), June 22, 1892, *Crandall* (G, NY), *Shear 4147* (NY, US). NEW MEXICO: Rio Medio, *H. P. Baker* in 1906 (US); Brazos Canyon, *Standley & Bollman 10808* (US). WASHINGTON: Nason Creek, *Sandberg & Leiberg 683* (US, CA), *638* (A, UC, NY); Scotia, *Jack 1475* (A); east of the Cascade Mts., *Wilkes Expedition 489* (US); Mt. Stuart, *Elmer 1269* (A), *Whited 811* (US); Easton, *Whited 424* (US), *Roell,* June 8, 1888 (A); Fish Lake, Kittitas Co., *Thompson 10658* (US, A, CA, G); Swauk River, *Sharples 109* (G); Mica Peak, *Suksdorf 8818* (A); Mt. Carleton, *Kreager 265* (US, G, NY); Blue Mts., *Horner 181* (US), *B181* (G), *Sargent,* July 31, 1896 (A); Mt. Adams, October 1, 1881, *Suksdorf* (US), *7096* (A); Yakima region *Brandegee* in 1882 (UC). OREGON: Hood River, September 1896, *Langille* (A); Mt. Hood, August 20, 1896, *Sargent* (A), *Heller 14721* (US, NY); between north and south Umpqua Rivers, alt. 5000 ft., *Applegate 2686* (US); Bone Springs, Wenaha Nat. Forest, *Lawrence 199* (US); Strawberry Range, *Mason 3526* (UC); Fish Lake, *Applegate 2496* (US); Huckleberry Mt., *Applegate 390* (A, US), *375, 1438* (US); Four Mile Lake, *Coville & Applegate 253* (US); Upper Metolius River, *Coville & Applegate 697* (US); Elgin, *Sheldon 8736* (A, US, NY); Crater Lake, *Gorman 41* (US), *Thompson 12298* (CA, US, A); John Day River, September 10, 1896, *H. E. Brown* (US, NY); Cornucopia, *Thompson 13414* (A, NY); Steins Mts., *Leiberg 2518* (UC, NY, US); Black Butte, *Cusick 2690* (US, UC); Lost Creek Valley, *Gorman 1823* (US). CALIFORNIA: Shackleford Creek, *Butler*

1681 (UC, US); Woolly Creek, *Butler 281* (UC, paratype of *S. sitchensis* var. *densa* Jeps.); Cliff Creek, *Culbertson 4674* (A, CA, UC, US, NY); Gold Lake, August 1919, *Mrs. E. C. Sutcliffe* (US, CA); Kaweah River, July 20, 1913, *Rixford* (A, CA); Grass Lake, *McGregor 98* (US, NY); Lassen Buttes, *Brown 660* (NY, US).

This is the species that was called *Sorbus sambucifolia* or *Pyrus sambucifolia* by the botanists of the nineteenth century. It is the commonest one in the western part of North America. Its habitat is chiefly canyons and wooded hillsides, and it is frequent up to an altitude of 10,000 feet. Throughout most of its range it occurs chiefly in the Canadian zone. It has the most extensive distribution of any western North American species.

Certain specimens from northern Idaho show a tendency to have slightly narrower and somewhat longer leaflets; these have been treated by Dr. Rydberg as a separate species, *S. angustifolia*. It is illustrated in Schneider's Ill. Handb. Laubholzk. *fig. 372f*. The type locality of this species is [Cedar] Moscow Mountain, so-called, one of the Thatuna Hills in Latah County, northern Idaho. At first glance this *S. angustifolia* appears to be a distinctive entity but close observation and an examination of a larger series of specimens than were available to Rydberg, shows that the leaflet character breaks down completely, and the plants intergrade with typical *S. scopulina*. This conclusion is based on the study of a large series of specimens, and Rydberg's type, as well as personal collections of material in the type region over a period of several years.

The herbarium specimen *Allen 291* (distributed as *Pyrus sambucifolia*) contains a mixture of *S. scopulina* and *S. cascadensis*. The flowering specimens belong, evidently, to *S. scopulina;* the fruiting specimen is of *S. cascadensis*. This mixture was noted by Schneider in 1906 (Bull. Herb. Boiss. II. 6: 314), but he erroneously ascribed the specimens with oval leaflets to *S. californica,* a species endemic to California, with smaller leaflets, glabrous pedicels, and the ciliations of the bud scales somewhat ferrugineous. The specimens of *S. scopulina* distributed with *Allen 291* are almost certainly not from native plants from Mount Rainier, but came, probably, from the eastern slope of the Cascade Mountains, or possibly from Mr. Allen's garden, situated between Longmire and Ashford, Washington. I found several different kinds of cultivated plants persisting near the remains of the Allen cabin as late as 1935, and among them were two or three species of *Sorbus*. On the lower slopes of the eastern watershed of the Cascade Mountains *S. scopulina* is conspicuous and not uncommon, and is in fact the only

species of the genus occurring there, but no authentic collections have come to hand from the region west of the summit of that range, neither has their existence been disclosed by personal field work in that region during a period of ten years.

Specimens of *S. scopulina* have been frequently misidentified as the wholly different *S. sitchensis,* which occurs in the United States only in northern Montana and adjacent Idaho. *Sorbus scopulina* can be readily distinguished by its acute or acuminate, glossy, oblong-lanceolate or elongate-oval leaflets with the serrations extending almost to the base, and by the glossy, bright scarlet, globose fruits. The pubescence of the pedicels and leaf-buds consists of whitish trichomes. In *S. sitchensis,* the oval, usually obtuse or obtusish leaflets are dull, the fruits are ellipsoid or subglobose, dull and glaucescent, and the pubescence is ferrugineous. In addition, the inflorescence is smaller, convex rather than flat-topped, and the stamens are shorter than the petals.

Following is an account of two natural intergeneric hybrids between *S. scopulina* and *Amelanchier florida* Lindl.

× **Amelasorbus Jackii** Rehder, Jour. Arnold Arb. 6: 154. 1925. *Amelanchier florida* Lindl. × *Sorbus scopulina* Greene. IDAHO: summit of Elk Butte, Clearwater Co., alt. about 2000 m., September 4, 1918, *Jack* 1329. Professor Rehder's comments on this bigeneric hybrid are as follows: "In general appearance the original specimens as well as the plants growing in the Arnold Arboretum have the aspect of a vigorous plant of *Amelanchier,* and only on closer inspection one may notice the presence of partly pinnate leaves and the compound inflorescence. The flowers, too, with their oblong upright petals look much like those of *Amelanchier,* but the styles are distinct, and the false partitions of the fruit extend only to about the middle of the locule and are abnormally thick in the sterile cells."

"The parents of the hybrid are apparently *Sorbus sitchensis* Roem. and *Amelanchier florida* Lindl. of which specimens were collected on the same date at the same locality; the first species being represented by Jack's no. 1333 and the second by his no. 1332. From *Sorbus sitchensis* the hybrid is easily distinguished by the mostly simple leaves, smaller, not viscid, winterbuds, the smaller paniculate inflorescence with racemose not corymbose branches, the oblong petals, 4–5 styles, and by the dark colored pruinose fruit with long ovate-lanceolate sepals. From *Amelanchier florida* the hybrid differs chiefly in the larger, more coarsely serrate and occasionally partly pinnate or lobed leaves, in the villous apex of the bud-scales, in the compound inflorescence, shorter petals, distinct styles and in the larger fruit with upright or nearly up-

right sepals, with shorter false partitions and with dry flesh of poor flavor as noted by the collector."

The type specimen and several additional sheets of × *A. Jackii* have been studied by the present writer; also a living plant in the Arnold Arboretum. Mr. Jack's specimen of the *Sorbus* that is presumably one of the parents of the hybrid (*Jack* 1333) also has been available for study. A critical examination of this specimen leads to the conclusion that it is better referred to *S. scopulina* Greene, rather than to *S. sitchensis* Roem. It is true that the leaflets are somewhat broader than those of most specimens of *S. scopulina,* but the large, flat-topped cluster of bright red, globose fruits, the glabrous petioles and rachises, and the glossy leaflets all demonstrate the specimen to belong to *S. scopulina,* the common species in the State of Idaho.

Additional specimens of × *Amelasorbus Jackii* Rehd. have been collected in the Wallowa Mountains of Oregon. These were discussed and illustrated by Rydberg in 1927 (Jour. N. Y. Bot. Gard, **28**: 227–228), but apparently he overlooked Rehder's article since no mention was made of it, nor were the specimens named. Dr. Rydberg's description is quoted in part as follows: "The sheet bears the number 1380 and is erroneously labeled *Pyrus sambucifolia.* . . . It is probably a hybrid between the Western Mountain Ash, *Sorbus occidentalis,* and a species of Juneberry, *Amelanchier.* The leaves have the light green color of *S. occidentalis,* but are thinner. Some of the earlier leaves are simple, but the rest are pinnate below, with 2 or 3 pairs of leaflets, which are like those of *S. occidentalis,* entire-margined below and dentate towards the apex. The terminal leaflet is much larger, broader, more toothed, and often lobed. The inflorescence is compound as in *Sorbus,* but the young fruit resembles that of *Amelanchier.*" Rydberg then concludes, and probably correctly, that the *Amelanchier*-parent is *A. florida* Lindl. It is almost certain, however, that the Sorbus-parent is *S. scopulina* rather than *S. occidentalis,* since the latter species is not known to occur in the Wallowa Mountains, or indeed anywhere within a distance of more than one hundred miles of them, whereas *S. scopulina* is common in that locality. Furthermore, the kind of pubescence, and the shape, texture, and serration of the leaf-segments of the Cusick specimens in the United States National Herbarium point unmistakably to *S. scopulina* and bring out more clearly than is done in Rydberg's illustration the obvious *scopulina*-character of the plants. The following specimen has been examined. Oregon: mountainsides near Cornucopia, *W. C. Cusick 1380* (US). Rydberg says (l. c.) that there is a duplicate sheet in the herbarium of the University of Minnesota.

5. **Sorbus alaskana** n. sp. Plate 226

Frutex; gemmae et ramuli juniores pilosi; folia 5–6-juga; foliola oblongo-lanceolata, 2–3-plo longiora quam lata, acuta, 3–5 cm. longa, 1–2 cm. lata, argute serrata, glabra; petioli rhachidesque glabri vel parce pilosi; corymbi circiter 3–6 cm. lati, convexi, ramis pilosis pilis brevibus albidis, flores 20–40, 6–8 mm. lati; hypanthium campanulatum, 3 mm. longum, sparse pilosum, sepala triangularia acuta ciliata 1 mm. longa; petala ovalia 5 mm. longa; stamina petala subaequantia; styli quatuor, 2 mm. longi; ovarium apice hirsutum; fructus globosi, 8–10 mm. crassi, coccinei; semina ovalia badia 4 mm. longa.

A shrub; winter-buds conical, glutinous, the outer scales ciliate, the inner pilose with whitish trichomes, as are also the young twigs; lenticels elliptical, scattered; leaflets 11–13, completely glabrous on both surfaces at maturity, the lateral ones widely spreading from the rachis at about a right angle when mature, firm, oblong-lanceolate, acute, 3–5 cm. long, 1–2 cm. wide, 2–3 times as long as wide, the lowermost pair usually somewhat smaller; margins sharply and regularly serrate almost to the base; upper surface dark green, glossy, glabrous at maturity, lower surface very slightly paler; terminal leaflet oval; petioles and rachises very sparsely pilose, or usually glabrous except for a few glands and often a few whitish trichomes on the upper side of the grooved rachis at the base of the leaflets; inflorescence roundish, compact, 3–6 cm. broad, less than 40-flowered; pedicels and peduncles pilose with whitish trichomes at flowering time; flowers 6–8 mm. in diameter; calyx sparsely pilose, the sepals triangular, acute, sparsely ciliate, 1 mm. long; petals oval, 4 mm. long, about the length of the stamens; styles 3–4, 2 mm. long, about half the length of the stamens; top of the ovary copiously pubescent; fruit bright red, subglobose, 8–10 mm. in diameter, less than 25 in a corymb; seeds oval, brown, 4 mm. long.

TYPE LOCALITY: Lake Iliamna, Alaska. Collected by M. W. Gorman in 1902.

RANGE: Alaska, from the head of Lynn Canal, westward to the upper Alaska Peninsula, northward to the lower Yukon valley.

ALASKA: Haines, *Scheuber*, July 1909 (US), *Anderson 828* (NY); Talkeetner Mts., *Anderson 1072* (US); Kussilof, *W. H. Evans 720* (US); Lake Iliamna region, *Gorman 85, 255* (TYPE US, A); Nushagak, *McKay* in 1881 (US); Kokrines, *Miller 1621* (US); Totanilla Mt., *Collier 132* (US); between Cook Inlet and Tanana River, *Glenn* in 1899 (US); Cook Inlet, *Coville & Kearney 2433* (US); Golovin, *L. J. Palmer 1063* (US); Alaska, without definite locality, *A. Kellogg* in 1867 (US);

Hyder, June 9, 1924, *Whited* (NY); Naknek Lake, July 17, 1919, *A. E. Miller* (US).

This species occurs on hillsides and in open woods. It is very similar in appearance to *S. scopulina* of the Rocky Mountains, especially in its leaf characters. The leaflets are almost identical with those of that species except that they are less glossy. However, the distinctive character that sets *S. alaskana* off at once from *S. scopulina* is its small, compact, rounded, fewer-flowered inflorescence, which in most specimens shows the calyces, pedicels, and peduncles to be much more pubescent than those of the Rocky Mountain shrub. *Sorbus scopulina* is not known to occur in Alaska. The two other Alaskan species are *S. sambucifolia* and *S. sitchensis*. The former is known to occur only on the westernmost islands of the Aleutian Archipelago. It is very distinct from *S. alaskana* in its ferrugineous pubescence, larger fruits and flowers, and the fewer, lanceolate or ovate-lanceolate, acuminate leaflets. *Sorbus sitchensis* has ferruginous pubescence, fewer, oval, obtuse, dull leaflets, a larger inflorescence, and glaucous fruits.

Mr. M. W. Gorman notes that the Kenai Indians use the branches for brooms in and about their houses, caches, and igloos. Also, "The branchlets are heated on hot rocks and used to beat the body in the sweathouses." The fruit is eaten and the bark chewed as a cure for coughs and colds. The native name is "buk-thilsh-nay." Gorman's no. 255 consists of two sheets, one of which contains a sterile specimen with very abnormal foliage. The other one is taken as the type.

6. **Sorbus decora** (Sarg.) Schneider, Bull. Herb. Boiss. II. **6**: 313. 1906, Ill. Handb. Laubholzk. **1**: 676, *f. 371 f-g.* 1906; Rehder in Bailey, Stand. Cyclop. Hort. 3195. 1917, Man. Cult. Trees Shrubs 377. 1927.

Sorbus Aucuparia var. β Michx. Fl. Bor. Am. **1**: 290. 1803.

Sorbus americana Pursh, Fl. Bor. Am. **1**: 341. 1814; Roemer, Syn. Mon. 138. 1847. Non Marsh. 1785.

Pyrus americana DC. Prodr. **2**: 637. 1825; Spreng. Syst. **2**: 511. 1825; Torrey & Gray, Fl. N. Am. **1**: 472. 1840 (excl. var. β); Nuttall, N. Am. Sylva **2**: 25, *pl. L.* 1853; Gray, Man. Bot. N. U. S. (ed. 1) 130. 1848.

Sorbus riparia Raf. New Fl. **3**: 15. 1836, nomen dubium.

Pyrus sambucifolia sensu Watson & Coulter in Gray, Man. (ed. 6) 164. 1889; Sargent, Silva N. Am. **4**: 81, *pl. clxxiii, clxxiv.* 1892; Dame & Brooks, Handb. Trees New Engl. 113, *pl. lviii.* 1902. Et auct. mult., non Cham. & Schlecht. 1827.

Sorbus sambucifolia sensu Dippel, Handb. Laubholzk. **3**: 368, *f. 191.* 1893. Non Roem. 1847.

Pyrus americana DC. var. *decora* Sargent, Silva N. Am. **14**: 101. 1902.

Sorbus americana Marsh. var. ["Hauptform"] *macrocarpa* Zabel, Handb. Laubholz-Ben. 195. 1903.

Sorbus americana Marsh. var. *decora* Sargent, Man. Trees N. Am. 357, *f. 281.* 1905; (ed. 2) 391, *f. 348.* 1922.

Sorbus scopulina sensu Hough, Handb. Trees U. S. Canada 241, *f. 280–281.* 1907; Britt. in Britt. & Brown, Ill. Fl. N. States (ed. 2) **2:** 287, *f. 2319.* 1913; Schaffner, Field Man. Fl. Ohio 307, 1928, Ohio State Univ. Bull. **36:** 155. 1932. Non Greene 1900.

Pyrus sitchensis sensu Robins. & Fernald in Gray, Manual (ed. 7) 459. 1908; Mathews, Field Book Am. Trees Shrubs 202 (excl. *f. opp. p. 202*). 1915. Non Piper, 1901.

Aucuparia subvestita Nieuwl. Am. Midl. Nat. **4:** 175. 1915.

Pyrus dumosa Fernald, Rhodora **23:** 266. 1921; Pease, Vasc. Pl. Coos Co. N. H. 266. 1924; Wiegand & Eames, Fl. Cayuga Basin 246. 1926. Non *S. dumosa* Greene, 1900.

Sorbus dumosa sensu House, N. Y. State Mus. Bull. **254:** 409. 1924. Non Greene, 1900.

Sorbus americana sitchensis Sudworth, Check List 133. 1927.

Sorbus subvestita sensu Rosendahl & Butters, Trees Shrubs Minn. 195, *f.* 1928; Deam, Shrubs Indiana (ed. 2) 148, *pl. 56.* 1932; Rydberg, Fl. Prairies Plains 438. 1932. Non Greene, 1900.

Pyrus subvestita Farwell, Am. Midl. Nat. **12:** 60, 122. 1930.

A small tree or shrub 6–12 m. tall and 30–40 cm. in diameter, with spreading branches and dark gray bark; winter-buds conical, the outer scales glutinous, reddish brown, dorsally glabrous, the inner scales merely ciliate with whitish or (when old) somewhat fulvous trichomes, or sometimes moderately pilose dorsally; young twigs glabrate; lenticels elliptical, scattered; leaflets 11–15, the lateral ones spreading from the rachis at about a right angle when mature, elliptical or oblong, acute, or abruptly short-acuminate, asymmetrical at the base, 4–8 cm. long, 1.5–2.5 cm. wide, 2–3 times as long as wide, the lowermost pair usually smaller; margins coarsely serrate to the middle or below, the teeth ovate, abruptly mucronate, 30–45 on each leaflet, 3–4 per cm.; upper surface dull, dark green, glabrous at maturity, lower surface paler, completely glabrous or sometimes more or less persistently sparsely pilose, at least along the midvein; terminal leaflet often obovate; petioles and rachises sparsely pilose or entirely glabrous, except for a few glands and often several long trichomes on the upper side of the grooved rachis at the base of the leaflets; inflorescence flat-topped, 8–15 cm. broad; pedicels and peduncles sparsely pilose with whitish trichomes; flowers about 1 cm. in diameter, fragrant; calyx sparsely pilose, the sepals triangular, sharply acute, 1 mm. long, sparingly ciliate, and sometimes with a few minute, dark marginal glands; petals broadly oval, 4 mm. long, somewhat truncate or slightly tapering at the base, about the same length

as the stamens; anthers 0.8 mm. long; styles 3–4, about 2 mm. long, much shorter than the stamens; top of the ovary pubescent; fruit bright scarlet or vermilion red, 8–10 mm. in diameter, subglobose; seeds lanceoloid, light brown, 4.5–5 mm. long, 1.5–2 mm. wide.

TYPE LOCALITY: "in Canada et circa lacum Ontario." (Michaux, l. c.).

RANGE: Newfoundland to Minnesota and southward to Iowa and New York.

NEWFOUNDLAND: Glenwood, *Fernald & Wiegand 5655* (G); Millerton Junction, *Fernald & Wiegand 5654* (G); Bay of Islands, *Fernald & Wiegand 3547* (A), *3548* (G), *Waghorne 41* (G); Bonne Bay, *Fernald & Long 1787* (G); Savage Cove, *Fernald, Pease & Long 28494* (G); St. Johns, *Bishop 369* (G, Can, A); Quarry, *Fernald & Wiegand 5653* (A, Can, NY); Grand Falls, *Fernald & Wiegand 5656* (A); Octagon, July 1902, *Dame* (A); Channel, *Howe & Lang 976* (NY); Whitbourne, August 15, 1894, *Robinson & Schrenk* (NY, Can, US); Port a Port, *Mackenize & Griscom 10323* (US). QUEBEC: Little Metis, July 6, 1906, *Fowler* (US); Sillery, *Adrien 1907* (Can); St. Agathe des Monts, August 26, 1902, *Jack* (A); Lake St. John, August 22, 1895, *Jack* (A); Seven Islands, *C. B. Robinson 877* (NY); St. Pierre Island, *Arsène 276* (NY), *307* (G); Cap à l'Aigle, *Macoun 67144* (NY, Can); Notre Dame du Lac, *Northrop 228* (NY); Ile au Marteau, *Marie-Victorin & Rolland-Germain 18700* (G); Bic, *Rousseau 26342* (A), *Fernald & Collins 1098* (Can); Montmorency Falls, *Macoun 67145* (Can). PRINCE EDWARD ISLAND: Charlottetown, *Fernald & St. John 7576* (A, US); Brackley Point, July 3, 1888, *Macoun 8183* (NY). NEW BRUNSWICK: Dalhousie, June 30, 1905, *Fowler* (US); Campobello Isl., *J. D. Smith, 888, 889* (US); Campbellton, June 4, 1876, *Chalmers* (Can). NOVA SCOTIA: Sandy Cove, *Fernald & Long 21427* (G, Can); St. Paul Isl., *Perry & Roscoe 240* (G, Can); St. John Lake, *Fernald, Bartram & Long 23928* (G); Yarmouth, *Jack 3781* (A); Clementsport, *Jack 3337* (A); Westville, *Jack 3279* (A); Port Bevis, *Fernald & Long 21430* (Can). MAINE: St. Francis, *Fernald 36* (NY, UC, US, NE); Mt. Desert Island, *Stebbins 238* (NE); Schoodic Mt., *Stebbins 435* (NE); Grand Isle, *Fernald 2306* (NE); Island Falls, *Fernald 2305* (NE). NEW HAMPSHIRE: Connecticut Lake, September 1895, *Mrs. A. F. Stevens* (US); White Mountains, June 13, 1879, *Pringle* (A); Mt. Willard, July 18, 1891, *Faxon* (A); Franconia, August 31, 1902, *Jack* (A); Mt. Lafayette, July 1879, *Sargent* (A); Mt. Washington, July 14, 1891, *Faxon* (A);

Moose River, *Pease 13651* (NE); Randolph, *Pease 18084* (NE); Mt. Moosilauke, *Underwood 2190* (NE); Woodstock, *Fernald 11718* (NE). VERMONT: Mt. Mansfield, *Pringle* in 1877 (UC, NY, US), *Greenman 951* (G), *Pringle* in 1879 (A). MASSACHUSETTS: Mt. Greylock, August 4, 1920, *Hoffman* (A). NEW YORK: Smith's Lake, August 22, 1879, *Ward* (US); Clear Lake, August 30, 1892, *Britton* (NY); Chazy Lake, August 22, 1922, *Susan D. McKelvey* (CA, A); Mt. Whiteface, August 8, 1894, *Jack* (A), August 10, 1902, *Rehder* (A); Oswego, *Fernald, Wiegand & Eames 14301* (G); Harris Lake, *Muenscher & Lindsey 3396* (G); Caroline, *Eames, Randolph & Wiegand 12149* (G). ONTARIO: Port Arthur, September 6, 1889, *Britton & Timmerman* (NY); Bruce Peninsula, *Dearness* in 1912 (Can); Whitefish Island, *Macoun 34401* (Can); Moose Factory, July 15, 1904, *Spreadborough* (Can). MICHIGAN: Fields, *Farwell 189* (G); Goose Island, *Gates 15241* (US), *Ehlers 428* (US, G); Hamlin Lake, *Chaney 254* (US, NY, G); Sault Ste. Marie, *McCullough 8261* (US); Cliff, *Hermann 7722* (US, NY); Neguanee, June 1902, *Rydberg* (NY); Vermillion, *Dodge 11* (A); Munising, *Gleason 952* (A). OHIO: Granville, October 25, 1902, *Condit* (UC). INDIANA: Laporte Co., *Orahood 40966* (A); Pokagon State Park, *Deam 54564* (A). IOWA: Fayette, *Gardner 33* (NY). WISCONSIN: Kilbourn, *Fassett 3450* (A, G), *Palmer 28415* (UC, US); Port Wing, *Fassett 10359* (G); Wyoming, *Fassett 12586* (US). MINNESOTA: Big Rice Lake, *Hotchkiss & Jones 451* (G, US); Knife River, June 1893, *Sheldon* (G, US, NY); Duluth, August 20, 1911, *Sargent* (A), *Olga Lakela 1422, 1834* (US, NY), *F. W. Johnson 1102* (US, NY); Itasca Park, *Moyle 390* (G, US, NY, UC); Itaska Lake, *Sandberg 1046* (US); Two Harbors, *Butters & Rosendahl 4470* (NY, G); Pokeguma Lake, *Sandberg 199* (A); Bear Lake, May 25, 1912, *Rosendahl* (A).

This species has a range similar to that of *S. americana*, but it occurs at somewhat higher altitudes and has a more northerly distribution. It is common in montane woods and along riverbanks and lake shores from Newfoundland to the mountains of northern New England, and westward along the shores of the Great Lakes to Minnesota, and southward to Iowa and New York. It is, however, absent from the Coastal Plain. There are several published records of it from as far west as Manitoba, but all these rest on erroneous determinations of *S. aucuparia*, which is frequently cultivated and has a strong tendency to take to the woods, often in places somewhat remote from the nearest human settlement, the seeds carried by birds. *Sorbus decora* is to be distinguished from *S. americana* by its larger and later flowers, the broader,

acute leaflets, and its much larger fruits. In herbarium specimens these often have a glaucescent appearance. It has been confused with several other species, including *S. sambucifolia* (Cham. & Schlecht.) Roemer, which is an entirely distinct low shrub of eastern Asia and the westernmost islands of the Aleutian chain. Some authors have identified the arborescent eastern shrub with one or more of the shrubby species of the Rocky Mountain region, particularly *S. scopulina* and *S. dumosa*. It is, however, quite different from any of those plants. Some other students have misapplied the name *S. subvestita* Greene to this species. It is perfectly clear, however, that Greene's rather meager description does not apply to *S. decora*. Any lingering suspicion of doubt on this point is immediately dispelled by a glance at a photograph or at an isotype of the specimen cited as *S. subvestita*. It is a typical sample of the European *S. aucuparia* L. found growing wild in the woods of Minnesota. Even the name *subvestita* is not appropriate for *S. decora*, since mature leaflets of the majority of the specimens of this species are almost glabrous except for some sparse pubescence along the lower part of the midvein on the lower or abaxial surface of the leaflet. Old leaves usually are completely glabrous throughout.

The name *S. riparia* Raf. is here rejected as a nomen dubium. Although it is possible that Rafinesque actually had seen a tree of the species we now name *S. decora*, his description is vague and uncertain and it seems undesirable to attempt to revive a doubtful name that has been dormant for over a century, and to try to establish it in preference to one based on an adequate foundation.

I have seen no conclusive evidence of hybridization between *S. decora* and any other species of *Sorbus*, although such hybrids may possibly occur. There are, however, specimens that have been described as hybrids between this species and members of the closely related genus *Aronia*. These were said originally by the describer, Bro. Louis Arsène, to represent a natural hybrid between *S. americana* Marsh. and *Aronia atropurpurea* Britt. [*A. prunifolia* (Marsh.) Rehd.], but later he identified the Sorbus-parent as the plant we now call *S. decora*. Following Schneider, and Rehder, and using a binary name instead of a formula for these plants, a new combination becomes necessary, and the synonymy is as follows:

× **Sorbaronia Arsenii** (Britt.) n. comb. *Sorbus decora* (Sarg.) Schneid. × *Aronia prunifolia* (Marsh.) Rehd.

Sorbus Arsenii Britt. ex Arsène, Rep. Bot. Exch. Club Brit. Isles **7**: 961. 1926.

Pyrus Arsenii Arsène, Rhodora **29**: 177. 1927.

Shrub 1–2.5 m. tall; leaves 2–7 cm. long, pinnate below, cleft or lobed above, the terminal segment largest; inflorescence resembling that of *Aronia*, the branches ascending.

Many of the leaves of this bigeneric hybrid are pinnatifid, or pinnate with 1–3 pairs of dentate or lobed, acute, mostly glabrous leaflets (or segments). The following specimens have been examined: Miquelon Isl., July 20, 1902, *Arsène* (G, NY), also July 25, 1902, *Arsène 308* (G, NY), *LeHors 292a* (G); Ethel Lake, St. Paul Isl., Nova Scotia, July 22, 1929, *Perry & Roscoe 242* (G).

6a. **Sorbus decora** var. **groenlandica** (C. Schneid.) n. comb.

Pyrus Aucuparia sensu E. Mey., Pl. Labrador. 81. 1830, ex parte. Non L. 1753.

Sorbus americana Marsh. var. *groenlandica* C. Schneid., Bull. Herb. Boiss. II. **6**: 314. 1906.

Shrub 1–3 m. tall; winter-buds somewhat glutinous, the outer scales reddish brown, nearly glabrous dorsally, the inner scales whitish-pilose; leaflets (11–) 13–17, oblong, sharply acute, 2–3 times as long as wide, sharply and somewhat irregularly simply or doubly serrate to below the middle; the upper surface dark green and glabrous at maturity, the lower surface pale green, glabrous or often sparsely pilose, at least along the midvein toward the base of the leaflet; terminal leaflet elliptical, petiolulate, the lateral ones nearly sessile; inflorescence 5–10 cm. broad; pedicels and peduncles whitish-pilose to glabrous; flowers 5–8 mm. broad; hypanthium glabrous or nearly so; sepals triangular, acute, 1.5–2 mm. long in anthesis, glabrous on the back, sparsely ciliolate to glabrous on the margins; petals about as long as the stamens, orbicular, 3–4 mm. long, the base truncate; styles 3, shorter than the stamens, 1.5 mm. long; fruits ellipsoid or subglobose, 5–7 mm. long, 5 mm. thick (in herbarium specimens), red, glossy or slightly glaucous; seeds lanceoloid, 4 mm. long, 2 mm. wide, brown.

TYPE LOCALITY: South Greenland.

RANGE: South Greenland and Labrador.

GREENLAND: Neria, July 26, 1923, *J. Eugenius* (G), July 24, 1926 (G), August 6, 1928 (Can), September 24, 1928 (Can), June 29, 1934 (Can); Tasermint, September 4, 1889, *Hartz* (Can); Kranifjord, August 18, 1922, *M. P. & A. E. Porsild* (G, Can); Kangikitsup Quinga, July 4, 1925, *M. P. & A. E. Porsild* (G, Can). LABRADOR: Deepwater Creek, September 17, 1892, *Waghorne* (Can); Battle Harbour, *Hitchcock 23854* (US), August 9, 1911, *Williamson* (NY); Hamilton River, *A. P. Low 4989* (Can); Cartwright, July 1928, *Malte* (Can); Georges

River, *Spreadborough 16312* (Can); Rigolet, September 24, 1926, *J. D. Soper* (Can); Hopedale, *Potter & Brierly 3087* (G), *Bishop 367* (G, A, Can); Windy Tickle, *Bishop 366* (G, A, Can); Salmon Bight, *A. E. Porsild 44* (Can, US); Turnavik, *A. E. Porsild 136* (Can); Assizes Island, *Potter & Brierly 3086* (G); Anatolak, *Sewall 501* (G, US); Aillek, *Sornborger 123* (NY, US); Esquimeaux River, July 27, 1882, *Allen* (G).

This plant is restricted to coastal Labrador and southern Greenland. It has been reported as *S. americana* and as *S. decora,* but it is somewhat different from each of those plants. It is said by Schneider (l. c.) to be more closely related to the former species ("Aehnelt in Serratur etc. der *americana* mehr als der *decora,* doch sichere Verwandtschaft fraglich"). However, the leaves, including the shape and pubescence of the leaflets, indicate a closer affinity with *S. decora;* likewise the structure of the flowers, the shape of the petals, and the relative length of the petals and stamens, and the size of the anthers, show a closer connection with the latter than with the former species. According to various published notes, and dates on herbarium sheets, *S. groenlandica* flowers during July and August. M. P. Porsild (Meddel. om Groenl. **77**: 18, 1930) reports it as occurring in Greenland "in all Alnus and Betula thickets visited but nowhere dominant." It occurs between 60° and 64° N. latitude in Greenland. In Labrador it grows at least as far north as latitude 56° N.

7. **Sorbus cascadensis** G. N. Jones, Univ. Washington Publ. Biol. **7**: 174. 1938. Plate 227

Sorbus sambucifolia sensu Howell, Fl. NW. Am. 164. 1898. Non Roemer, 1847.

Pyrus sitchensis Piper, Mazama **2**: 107. 1901, Contr. U. S. Nat. Herb. **11**: 347. 1906, ex parte; Henry, Fl. S. Brit. Col. 183. 1915; Gilkey, Handb. NW. Flow. Pl. 148. 1936.

Sorbus sitchensis sensu Benson, Contr. Dudley Herb. Stanford Univ. **2**: 101. 1930. Non Roemer, 1847.

Sorbus dumosa sensu G. N. Jones, Univ. Washington Publ. Biol. **5**: 180. 1936. Non Greene, 1900.

Shrub 2–5 m. tall, forming clumps, the branches suberect, with smooth, gray bark; winter-buds and young twigs pubescent; lenticels numerous, roundish; leaves odd-pinnate, 15–20 cm. long; petioles and rachises sparsely pilose to completely glabrous; leaflets 9–11, nearly equal, oval, abruptly acute at the apex, obliquely acute to somewhat rounded at the base, glabrous on both surfaces, dark and somewhat glossy green above, pale green beneath, coarsely and sharply serrate from the apex to below the middle, 5–7 cm. long, 2–3 cm. wide; terminal

leaflet obovate, abruptly apiculate-acute; inflorescence 7–12 cm. broad, 30–60-flowered, somewhat convex, the pedicels and peduncles sparsely pilose with short, white trichomes; flowers white, fragrant, 8–10 mm. in diameter; calyx-tube campanulate, 3 mm. long, glabrous to sparsely pilose; sepals triangular, acute, ciliate, 1.5 mm. long; petals orbicular, 5–6 mm. long, longer than the stamens; styles usually 4, 2 mm. long, much shorter than the stamens; anthers 1 mm. long; fruit globose, scarlet, 8–10 mm. in diameter; seeds ovoid, flattened, dark brown, 4 mm. long, 2 mm. wide.

TYPE LOCALITY: Mount Rainier, Washington.

RANGE: Southern British Columbia, southward in the Olympic and Cascade mountains to northern California.

BRITISH COLUMBIA: Sproat, *Macoun 8217* (Can); Chilliwack Lake, *Spreadborough 79775* (NY); near Shawnigan Lake, *Canby, Sargent & Muir 66* (US, G). WASHINGTON: Mt. Angeles, July 6, 1921, *Taylor* (CA); Dosewallips River, July 30, 1921, *Taylor* (CA); Skagit Pass, August 24, 1892, *Lake & Hull* (NY); Copper Mt., *Gorman 726* (US); Billygoat Pass, *Eggleston 13525* (US); Stehekin, *Griffiths & Cotton 204* (NY, US); Chiwaukum Creek, *Eggleston 13537* (US); Ashford, *Allen* (A); Mt. Rainier, *Jones 9924* (G, TYPE), *Piper 1990* (G, US, A); Bear Prairie, Mt. Rainier, *Allen 291* in part (US, G, NY, UC); Fort Colville to the Rocky Mts., *Lyall* in 1861 (G); Cascade Mts., lat. 49° *Lyall* in 1859 (G); Mt. St. Helens, *Coville 791* (US), *Walpole 25* (US); Cascades, *Kellogg & Harford 227* (NY). OREGON: Cascade Mts. August 4, 1880, *Engelmann & Sargent* (A); Mt. Hood, *Benson 2517* (NY, UC, US), *Henderson 890* (G), *Coville 891* (US); Lost Lake, *Henderson 889* (G); Deadner Mt., near Weiner, *Walpole 85* (US); Crater Lake, *Heller 12950* (NY, US, G, CA), *Henderson 1764, 1533* (G), *Thompson 12298* (NY); Klamath Lake, August 29, 1896, *Sargent* (A); Ashland, August 27, 1896, *Sargent* (A). CALIFORNIA: Hilt, October 1912, *L. E. Smith* (CA); Hatchet Creek Mts., May 24, 1894, *Baker & Nutting* (UC); Butte Creek, *Heller 14706* (NY, US); Sisson, *Eastwood 2083* (A, US, CA); Salmon Mts., *Eastwood & Howell 5039* (A, CA); Castle Lake, *Eastwood 10761* (A, CA), July 27, 1911, *Condit* (CA); Lake City Canyon, *Austin & Bruce 2356* (NY); Trinity Summit, *Tracy 5292* (UC); Taylor Creek, *Baker 475* (UC); Colby, *Austin 751* (US); Warner Mts., *Griffiths & Hunter 450* (US).

This species is closely related to *S. californica* Greene. It is, however, a more robust shrub with larger, abruptly acute, oval leaflets; the pedicels are white-pilose, and the petals larger. It occurs from northern

California to the Cascade and Olympic Mountains of Washington, and adjacent British Columbia. It has been erroneously ascribed to several other, distantly related species, particularly to S. *sambucifolia* (Cham. & Schlecht.) Roemer, and *S. sitchensis* Roemer. In 1901 Piper pointed out that it is not conspecific with the Asiatic *S. sambucifolia* (at that time not known to occur in North America); instead, he stated that it is identical with the Alaskan plant described by Roemer as *S. sitchensis*. Since that time most botanists have been more or less content to follow his lead, and no less than four totally different species have been called "*sitchensis*." Recently, however, the identity of Piper's *Pyrus sitchensis* with Roemer's *Sorbus sitchensis* has been questioned, and the present writer (Univ. Wash. Publ. Biol. **5**: 180. 1936) concluding that the shrub of the Cascade and Olympic Mountains could not be the latter species, assumed on the basis of wholly inadequate evidence, that it is conspecific with *S. dumosa* Greene of Arizona. This is, however, not correct. Neither is it the *Pyrus dumosa* of Fernald, which turns out to be the quite distinct arborescent *S. decora* of eastern North America.

In Washington and Oregon *Sorbus cascadensis* has much the same distribution as *S. occidentalis*, but the two species seldom grow together in the same habitat. It is almost entirely a species of the Canadian zone, while the latter is definitely Hudsonian. Its usual altitudinal level in the northern half of its range is about three thousand feet, but it ascends to six thousand feet in the vicinity of Crater Lake in the Cascade Mountains of southern Oregon. The two species are entirely distinct phylogenetically, and it is difficult to see how botanists ever could have confused them. *Sorbus occidentalis* has a near affinity with *S. sitchensis*, as indicated by the glaucescent fruits, shape and size of the inflorescence, ferrugineous pubescence, the shape of the leaflets, and the shape of the petals and the relative length of petals and stamens, while *S. cascadensis* is connected with *S. scopulina* of the Rocky Mountains through *S. californica*.

As noted above, *S. cascadensis* frequently has been confused with *S. sitchensis*. That species is quite distinct, however, in its glaucescent fruits, dull, usually more obtuse and more coarsely serrate leaflets, the teeth usually fewer, the smaller inflorescence, and the pubescence of the pedicels and bracts tawny or rufous; in addition it has a more northerly and easterly range.

In many respects *S. cascadensis* closely resembles, and is doubtless nearly related to, *S. scopulina* which occurs on the eastern slope of the Cascade Mountains and ranges eastward to the Black Hills of South Dakota. The shrub of the region west of the summit of the Cascade

Mountains differs in its usually fewer flowers and fruits, in its shorter stamens, more convex inflorescence, and its broader, less glossy, usually more coarsely serrate leaflets. These are oblong-oval, abruptly acute (instead of linear-lanceolate or oblong-lanceolate and acuminate as in *S. scopulina*), and at maturity are spreading at right angles from the rachis in the manner of those of the eastern American *S. decora*.

8. **Sorbus californica** Greene, Pittonia **4**: 131. 1900; Schneider, Ill. Handb. Laubholzk. **1**: 671, *f. 366, i-k.* 1906.

Pyrus sambucifolia sensu Brewer & Watson, Bot. Calif. **1**: 189. 1876. Non Cham. & Schlecht. 1827.

Sorbus occidentalis sensu Greene, Fl. Franciscana 54. 1891; Coville, Contr. U. S. Nat. Herb. **4**: 97. 1893. Non Greene 1900.

Sorbus sitchensis sensu Hedlund, Svenska Vet.-Akad. Handl. **35**: 40. *f. 4.* 1901, ex parte. Non Roem. 1847.

Pyrus occidentalis sensu H. M. & C. C. Hall, Yosemite Flora 124. 1912. Non Wats. 1888.

Pyrus sitchensis Piper var. *californica* Smiley, Univ. Calif. Publ. Bot. **9**: 233. 1921.

Pyrus sitchensis sensu Jepson, Man. Fl. Calif. 508, *f. 506.* 1925, Fl. Calif. **2**: 230. 1936. Non Piper 1901.

A many-stemmed shrub 1–2 m. tall; winter-buds glutinous, the inner scales sparsely ferrugineous-ciliate; young twigs glabrous, the lenticels inconspicuous, oval; leaflets 7–9 or –11, oblong-oval, obtuse or acutish, sharply and coarsely singly or often doubly serrate to below the middle, 1–2 cm. wide, 2–4 cm. long, glabrous on both sides, somewhat glossy above, paler beneath, the terminal leaflet obovate; petioles and rachises glabrous; inflorescence few-flowered, 4–10 cm. broad, somewhat convex on top; pedicels and peduncles glabrous; calyx glabrous, campanulate, 3 mm. long, the sepals ciliolate, triangular, acute, 2 mm. long; petals orbicular, 3–4 mm. long; stamens shorter than the petals, longer than the styles; anthers 1 mm. long; styles four 1.5–2 mm. long; ovary pubescent on top; fruit scarlet or coral-red, ellipsoid or somewhat pyriform, not glaucescent, 7–10 mm. in diameter; seeds oval, slightly flattened, light brown, acute at one end, 4 mm. long, 2 mm. wide.

Type locality: Sierra Nevada, California.

Range: California and western Nevada.

California: Big Meadows, August 27, 1904, *Rehder* (A), *Butler 282* (UC); Marble Mt., *Chandler 1633* (UC); Medicine Lake, *Baker 471* (UC); Union Lake, *Hall 8621* (US); Trinity Summit, *Davy & Blasdale 5835* (UC); Lasseck Peak, *Goddard 694* (UC); Lassen Butte region, *Eastwood 1760* (CA); Mt. Lassen, Sept. 6, 1931, *Jussel* (CA); Long Lake, *Bacigalupi 1655* (A); Soapstone Ridge, *Heller 12059* (CA,

G, A); Feather River Region, August 2, 1921, *Head* (CA); Long Valley, *Eastwood 14638* (CA, A); Mineral King, *Coville & Funston 1425* (US), July 28, 1892, *Brandegee* (A, UC); Mt. Elwell, *Hall 9340* (UC, US); Jamison Lake, *Rose 32624* (CA); Greenville, October 20, 1919, *Mrs. J. Clemens* (CA); N. Fork Stanilaus River, June 28, 1930, *Jussel* (CA); Crystal Lake, *Mary Strong Clemens* in 1920 (CA); Lake Lucille trail, *Eastwood 1031* (A, CA); toward Summit, July 1897, *Sonne* (A); near Summit, *Heller 7026* (A, US, G, UC, NY), July 1876, *Edwards* (NY), *Heller 9835* (A, G, NY), July 9, 1870, *Kellogg* (CA), *Brandegee* (CA); Cisco, *Walker 1445* (UC); Ebbet's Pass to Summit, *Brewer 2091* (SYNTYPE UC, US); Deer Park, *Eastwood 314* (CA); Grass Lake, July 23, 1923, *Blasdale* (UC); Emerald Bay, Lake Tahoe, September 22, 1925, *Louise Bartholomew* (CA); Heather Lake, *Wolf 2406* (UC); Rubicon Springs, August 1924, *Mrs. Engel* (CA); Pyramid Peak, *Smiley 76* (G); Mt. Tahoe, *Abrams 4814* (G, NY); summit of Sierra Nevada, *Bolander* in 1873 (US); Sierra Nevada Mts., *Lemmon* in 1875 (US); Marble Fork, *G. B. Grant 1518* (US); Ralston Peak, *Smiley 416* (G); Huntingdon Lake, July 1926, *Alice Griffin* (CA); Vidette Lake, July 1916, *Mrs. M. L. Campbell* (CA); without locality, *Bolander 2091* (UC); Glen Alpine, *J. T. Howell 1317* (CA), September 1904, *Catherine Chandler* (UC), *Abrams 12758* (NY, G, UC), July 1, 1898, *W. W. Price* (UC); Tioga Pass, September 15, 1923, *Mason* (UC); Gaylor Lakes, August 9, 1923, *Mason* (UC); Tuolumne region, July 25, 1889, *Chestnut & Drew* (UC); Dog Lake, *Smiley 837* (G); Pine Ridge, *Hall & Chandler 333* (UC); Tamarack Beach Camp, July 1914, *Wieslander* (UC); Shut Eye Pass, *Abrams 4943* (A, G, NY); Shuteye Mt., *Murdoch 2520* (NY); Isberg trail, *Zentmyer 2002* (UC); between Lake Tenaya and Cathedral Lake, *Eastwood 444* (CA); Buck Canyon, Kaweah River region, *Hopping 54* (UC); Emerald Lake, Sequoia Nat. Park, July 25, 1932, *Darland* (UC); Farewell Gap, Tulare Co., *Culbertson 4527* (G, CA); Fallen Leaf Lake, *Wolf 1715* (CA). NEVADA: Washoe Co., *Kennedy 1461* (NY, UC, US); Snow Valley, *Baker 1281* (NY, UC, CA, US, A); Slide Mt., *Nordstrom 979* (UC), *Heller 10929* (NY, UC, US, A); Donner Lake, July 10, 1902, *Diehl* (CA, A).

Sorbus californica is restricted to California and western Nevada. In California it grows along streams or on moist steep slopes in the Canadian and Hudsonian zones of the Sierra Nevada from Tulare County to Modoc County at altitudes of 5000–10,000 feet, and in the North Coast Ranges from Humboldt County to Siskiyou County. From *S. scopulina,* which occurs in California only along the eastern border

of the state from Modoc County to Tulare County, it is to be distinguished by its fewer, oval, obtusish, less finely serrate leaflets, the sparsely ferrugineous-ciliate inner scales of the winter-buds, the fewer-flowered, round-topped inflorescence with glabrous peduncles, the shorter styles and the oval, slightly broader seeds. *Sorbus cascadensis* extends southward as far as the northern part of the state of California, and is found chiefly in Siskiyou, Humboldt, Modoc, and Butte counties. It is a more robust shrub with usually 11, larger, more coarsely serrate, abruptly acute leaflets, pilose peduncles, larger inflorescence, longer petals, and larger, more pubescent winter-buds.

9. **Sorbus sitchensis** Roemer, Syn. Mon. **3**: 139. 1847; Hedlund, Svenska Vet.-Akad. Handl. **35**: 41. 1901, ex parte; Standley, Contr. U. S. Nat. Herb. **22**: 366. 1921; Rehder, Man. Cult. Trees Shrubs 378. 1927; Raup, Contr. Arnold Arb. **6**: 173. 1934.

Pyrus sambucifolia sensu Bong. Mém. Acad. St. Pétersb. VI, **2**: 134. 1832 (repr. Veg. Sitcha 16); Henshaw, Mt. Wild Fls. N. Am. 336, *pl. 91*. 1906. Non Cham. & Schlecht. 1827.

Sorbus occidentalis sensu Coville, Contr. U. S. Nat. Herb. **3**: 339. 1895; Rydberg, Fl. Rocky Mts. 448, 1917; Kirkwood, Rocky Mt. Trees Shrubs 199. 1930. Non Greene, 1900.

Sorbus Tilingii Gandoger, Bull. Soc. Bot. France **65**: 25. 1918, ex parte.

A shrub 1–4 m. tall; winter-buds ellipsoid, rufous pubescent; young twigs rufous puberulent; lenticels linear or oval; stipules linear-lanceolate, 6–9 mm. long, rufous pubescent; leaflets 9–11, oval or oblong, 4–7 cm. long, 1.5–3 cm. wide; apex obtuse or acutish; margins rather coarsely and sharply serrate to the middle or below; teeth usually 16–40 on each leaflet; upper surface dull, glabrous; lower surface somewhat paler, glabrous at maturity, or pubescent along the midvein; petioles and rachises finely pubescent or pilose, glabrate in age; inflorescence round-topped, 5–9 cm. broad, 40–60-flowered; pedicels and peduncles rufous pubescent to nearly glabrous; flowers 6–9 mm. broad, fragrant; calyx 3–3.5 mm. long, glabrous on the back, campanulate; sepals ciliolate; petals oval, 5 mm. long, longer than the stamens; styles 1.5–2 mm. long; top of the ovary pubescent; fruit subglobose to ellipsoid, red, becoming orange and finally purplish, glaucescent, 8–10 mm. in diameter; seeds dull brown, ellipsoid or ovoid, 3–4 mm. long, 2–2.5 mm. wide.

TYPE LOCALITY: "In insula Sitcha ad oram occidentalem Americae borealis." Collected by Mertens.

RANGE: Alaska and Yukon through British Columbia to northwestern Montana and adjacent Idaho.

ALASKA: Port Etches, *Macoun 19930* (Can); McDonald Lake,

Burcham 107 (US); north of Mt. St. Elias, *D. W. Eaton 2;* Seldovia Bay, July 12, 1913, *Griggs* (US); Halibut Cove, *Coville & Kearney 2433* (US); Yes Bay, *Gorman* in 1894 (UC), *Gorman 41* (NY, US); Juneau, *Walpole 1234* (US), *Jepson 477* (US); Yakutat Bay, *Coville & Kearney 1157* (US); Muir Inlet, *Coville & Kearney 690* (US); Amalik Bay, *Henning 554* (US); between Skagway and White Pass, *Coville & Kearney 502* (US); Wrangel, *Coville & Kearney 445* (US), *Evans 64* (US); Sitka, *Coville & Kearney 875, 915* (US), *Anderson 118* (US), *Canby, Sargent & Muir 64* (UC); New Metlakatla, September 2, 1897, *Sargent* (A); Disenchantment Bay, *Funston 92* (US, UC, Can); Ketchikan, July 6, 1909, *Kellogg* (US); Heather Island, *Coville & Kearney 1348* (US); Loring, *Chamberlain 71,* (US); Prince William Sound, *Edmund Heller 45* (UC), *Evans 294* (US); Orca, *Coville & Kearney 1319* (US); Kukak, July 1899, *Kincaid* (A); Nakuk Lake, July 17, 1919, *A. E. Miller* (US); Alaska Mts., *Bayne Beauchamp Exped. 30* (UC). British Columbia: Bennett, August 25, 1899, *Williams* (US); Lake Bennett, *Dawson 8210* (Can); Glacier, *Canby, Sargent & Muir 63* (G, US), July 29, 1909, *Rusby* (NY), August 14, 1904, *Jack* (A), August 13, 1904, *Rehder* (A), August 1897, *Sargent* (A), July 30, 1916, *Hunnewell* (G); Cumshiwa Inlet, Queen Charlotte Islands, *Osgood* in 1900 (US); Dawson Harbour, June 24, 1897, *Newcombe* (Can); Skagit River, *Macoun 69919* (Can); Chilliwack Valley, *Macoun 34379, 34381* (Can, US, G, NY), *34380* (US, G, NY, Can); Great Northern Mountain, August 2, 1904, *Scheuber* (US); Asulkan Valley, August 14, 1904, *Rehder* (A); Talliser, August 13, 1904, *Rehder* (A); Mt. Selwyn, *Raup & Abbe 4043, 4070* (A, Can); White Pass, (Yukon) *Eastwood 904* (A). Alberta: Whistlers Mt. Jasper Park, *Jack 2701* (A); Lake Louise, *Macoun 65116* (NY, Can, G), July 24, 1916, *Hunnewell* (G). Montana: Lake McDonald, *Umbach 328* (NY); MacDougal Peak, *MacDougal 815* (NY, US, A); Essex, *Williams 1069* (NY, US, G); Mt. Silcox, *Butler 5097* (NY); Snyder Lake, *Standley 17961* (US); Grinnell Lake, *Standley 15226* (US), *Jack 2107* (A); Grinnell Glacier, August 31, 1921, *McKelvey* (A); Sperry Glacier, *Standley 18082* (US); Granite Park Chalets, *Standley 16131* (US); Gunsight Pass, *Standley 18210* (US); Iceberg Lake, *Standley 15381* (US); Glacier National Park, *Hitchcock 11945* (US); Gunsight Lake, *Jack 2245* (A). Idaho: Divide between St. Joe and Clearwater River, *Leiberg 1248* (A, NY, G, US); Bear Creek Canyon, *Leiberg 2967* (US); Upper Priest River, *Epling 7931* (US); Weissners Peak, *Leiberg 1668* (US).

Although this is one of the most distinctive species in the genus, and

bears no close resemblance to any other except *S. occidentalis,* it has been persistently misunderstood, probably on account of inadequate herbarium material for study, and the rather unsatisfactory original description by Roemer. Hedlund, the monographer of *Sorbus,* completely misinterpreted it, and had it confused, not only with *S. occidentalis,* but with *S. californica* as well. As an example of his almost complete lack of knowledge of this plant, he says that it "scheint der S. americana am nächsten zu stehen." Schneider, although recognizing the distinctness of *S. californica* and *S. occidentalis,* reduces the latter to a synonym of *S. pumila* (*S. sitchensis*). Piper was even further from the mark when he mistook the shrub of the Cascade Mountains, herein called *S. cascadensis,* for *S. sitchensis,* which differs in its ellipsoid, dull, glaucescent fruits, smaller, convex inflorescence, ferrugineous pubescence, shape and serration of the smaller, dull, usually obtusish leaflets, and the wholly separate geographical distribution. *Sorbus cascadensis* has globose, scarlet, glossy fruits in denser, flat-topped clusters, the acute, glossy, somewhat larger leaflets serrate almost to the base, and the sparse pubescence of whitish trichomes. Rydberg, in his usually critical *Flora of the Rocky Mountains* (1917), came nearer than any of his predecessors to an understanding of *S. sitchensis,* but even he called it *S. occidentalis,* giving as a possible synonym: "(?) *S. sitchensis* Roem." Standley (Flora of Glacier National Park, 1921) appears to have been the first modern botanist to interpret correctly this species, which ranges from southern Alaska, across British Columbia, and southward to northern Montana and adjacent Idaho. As far as is known, it is the only species of mountain-ash occurring at Sitka, Alaska, the type locality.

Sorbus sitchensis is most closely related to *S. occidentalis,* from which it may be readily distinguished by the thicker, coarser, somewhat coriaceous, sometimes acutish leaflets that are serrate to the middle or below, and the glabrous or nearly glabrous rachises. In addition, the inflorescence is more densely flowered, and the styles are fewer (3–4) and shorter (1.5–2 mm. long).

Occasional specimens from Glacier National Park, Montana (*Standley 15747, 17566, 18452,* US), have acute, less coarsely serrate leaflets and larger inflorescences, suggesting a hybrid origin with *S. scopulina,* which is a common shrub in that region.

In 1918, M. Gandoger proposed *Sorbus Tilingii,* basing it upon one specimen from Sitka, Alaska, collected by Tiling, and four other specimens from various parts of the United States, as well as three from northeastern Asia. Through the courtesy of M. Douin of the Univer-

sité de Lyon, and the co-operation of Dr. Leon Croizat of the Arnold Arboretum, I have been able to examine Gandoger's herbarium material of this proposed species. The holotype turns out to be a topotype and a typical specimen of *S. sitchensis*. The four North American paratypes consist of two sheets of *S. scopulina* (Montana: *Williams;* Colorado: *Crandall*), one of *S. decora* (Vermont: *Pringle*); and one of the European *S. aucuparia* (Illinois: *Bross*) that has become naturalized in that State. The three Asiatic specimens are labelled *S. sambucifolia;* they belong, however, to some other oriental species, possibly *S. discolor* Maxim. Thus it is plain that Gandoger has not described a new species, but has merely applied a new name to a group of miscellaneous herbarium specimens belonging to no less than five different species, of which four are already well known North American plants. The name *S. Tilingii* becomes accordingly a synonym of *S. sitchensis*.

Bongard (l. c.) reports from Sitka a small-leaved variety as follows: "Huic adjungimus varietatem *microphyllam,* foliis quam in praecedente triplo minoribus insignem, quam autem, floribus fructibusque deficientibus definire nequimus." The significance of this reference has not been ascertained. As previously noted, the only species of *Sorbus* known to occur at Sitka is *S. sitchensis* Roemer.

10. **Sorbus occidentalis** (Wats.) Greene, Pittonia **4:** 131. 1900; Howell, Fl. NW. Am. 164. 1898; Benson, Contr. Dudley Herb. Stanford Univ. **2:** 102. 1930; Jones, Univ. Washington Publ. Biol. **5:** 180. 1936, op. cit. **7:** 108. 1938.

Sorbus pumilus Raf. Med. Fl. **2:** 265. 1830, *nomen subnudum;* Hedlund, Svenska Vet.-Akad. Handl. **35:** 39. 1901; Schneider, Ill. Handb. Laubholzk. **1:** 669, *f. 366 g-h.* 1906, excl. syn. *S. sitchensis;* Rehder, Man. Cult. Trees Shrubs 378. 1927.

Sorbus humifusa Wats. Bibliogr. Index 290. 1878 (error in transcription).

Pyrus occidentalis Wats. Proc. Am. Acad. **23:** 263. 1888; Piper, Contr. U. S. Nat. Herb. **11:** 347. 1906; Henry, Fl. S. Brit. Col. 183. 1915; Gilkey, Handb. NW. Flow. Pl. 148. 1936.

Sorbus sambucifolia Roemer var. *Grayi* Wenzig, Bot. Centralbl. **35:** 342. 1888.

Pyrus sambucifolia var. *pumila* Sargent, Silva N. Am. **4:** 82. 1892.

Sorbus sambucifolia Roemer var. *pumila* Koehne, Deutsche Dendrol. 247. 1893.

Shrubs 1–3 m. tall, with gray bark; winter-buds ellipsoid, 5–7 mm. long, rufous pubescent; young twigs finely pubescent or puberulent; lenticels numerous, oblong; leaflets 7–11, thin, perfectly glabrous at maturity, oblong to oval (rarely somewhat lanceolate), 2–6 cm. long,

8–25 mm. wide, acutish at the base, the apex always rounded or obtuse, or even truncate, frequently minutely apiculate by the shortly excurrent midvein; margins entire except at or near the apex, or sometimes with a few teeth toward the middle; teeth 0–15, usually 6–12, obliquely lanceolate, acuminate, incurved, 3–4 per cm.; upper surface of leaflets dull, pale bluish-green, lower surface paler, reticulate; terminal leaflet oval; petioles and rachises finely pubescent, less commonly nearly glabrous; inflorescence 3–6 cm. broad, compact, convex on top, 15–40-flowered, the flowers about 1 cm. in diameter; pedicels, peduncles, and bracts more or less rufous pubescent to nearly glabrous, the bracts tardily deciduous, linear, acute, 2–10 mm. long; calyx campanulate, glabrous, 3–4 mm. long, the sepals 1–1.5 mm. long, ciliate; petals oval, very shortly clawed, 3–4 mm. long, often slightly pubescent on the upper surface near the base; stamens much shorter than the petals; anthers 0.5–0.7 mm. long; styles 5, about 3 mm. long; top of the ovary pubescent; fruit red, glaucescent, ellipsoid, 6–8 mm. in diameter, 7–10 mm. long; seeds castaneous, oval or ovoid, acute at the base, slightly flattened and oblique, 3.5 mm. long, 2.5 mm. wide when mature.

TYPE LOCALITY: Cascade Mountains, 49° N. latitude. Collected by David Lyall.

RANGE: Southwestern British Columbia to Oregon in the Cascade Mountains and the Coast Range, at altitudes of 4000 to 7500 feet, and one known station in Siskiyou County, California. Chiefly Hudsonian.

BRITISH COLUMBIA: Skagit Valley, *Macoun 69916, 69917, 69918* (NY, Can); Chilliwack Valley, *Macoun 34373, 34374, 34377, 34378,* (US, Can, G, NY), *34375, 34376* (US, Can). WASHINGTON: Cascade Mountains, lat. 49°, *Lyall* in 1859, TYPE (G); Olympic Mountains, August 18, 1896, *Sargent* (A), *Piper 423* (A), *Elmer 2509* (A, US, NY); Mt. Baldy, *Lamb 1365* (A, NY), *Conard 304* (US, G, NY); Bridge Creek, *Elmer 663* (NY, US, A); Lake Chelan, *Dr. Kuhn* in 1856 (NY); Yakima region, *Brandegee* in 1882 (UC); Mt. Shuksan, *Benson 2413* (NY, US); Mt. Baker, *Gorman 2514* (UC), *Hitchcock 12274* (US); Welcome Pass, *Thompson 8071* (G, UC); Skagit Pass, August 1892, *Lake & Hull* (NY); Stevens Pass, *Benson 2352* (NY, US, UC), *Sandberg & Leiberg 750* (A, G, CA, US, UC, NY), *Whited 1429* (US); Horseshoe Basin, *Gorman 795* (US); Mt. Dickerman, *Thompson 8876* (US, A); headwaters of the Stehekin River, October 5, 1904, *Sudworth* (US); Tye, *Otis 709* (CA); Mount Rainier, *Allen 125* (NY, UC, US), *125a* (NY, G, UC, US, A), *Benson 2324* (US, UC, NY), July 1897, *Flett* (US), *Mrs. Bailey Willis* in 1883 (NY), August

20, 1904, *Jack* (A), same date, *Rehder* (A), August 8, 1896, *Sargent* (A), *Grant* in 1925 (CA), *M. Baker 675b* (CA), *Eastwood 1060* (CA), *C. H. Merriam* in 1897 (US), *Piper 1988* (A, US), *H. E. & S. T. Parks 21008* (US, UC), *21054* (G, UC), *Esther Perry,* August 1931 (UC), *Munz 9933* (G), *G. N. Jones 6099, 10264, 10285* (G); Mt. St. Helens, *Walpole 24* (US), *Coville 789, 790, 812* (US), *Thompson 12667* (NY, A); Mt. Adams, August 7, 1894, *Lloyd* (NY); Skamania Co., *Suksdorf* in 1886 (G). OREGON: Mount Hood, August 20, 1896, *Sargent* (A), *C. H. Merriam* in 1896 (US), *Langille 115* (US), *Walpole 96* (US), *Applegate 2874, 2809* (US), *Thompson 4923* (US), *Mrs. E. C. Van Dyke* in 1928 (CA), *Benson 2518* (NY, US), July 22, 1894, *F. E. Lloyd* (NY), *Thomas Howell 1497* (US, UC, NY); Marion Lake, *Coville & Applegate 1155* (US); Three Sisters, *Coville & Applegate 558* (A, US), *Gorman 1715* (US); Mt. Jefferson, *Peck 9177* (NY), *Coville & Applegate 1178* (US), *J. C. Nelson 2876* (G); Metolius trail, near Ann Lake, *Coville & Applegate 1161* (US).

This very distinctive shrub is most closely related to *S. sitchensis* Roem., and frequently has been mistaken for that species. It is attributed to the Rocky Mountain area by Rydberg but it does not extend that far eastward. The Rocky Mountain material so described and identified is *S. sitchensis*. The leaflets of *S. occidentalis* are different from those of any other North American species in being entire for most of their length. Occasionally they are entire throughout. The teeth are seldom more than about fifteen, the usual number ranging from six to twelve. They are confined to near the apex of the obtuse, or sometimes truncate, leaflet. Rarely does the serration extend to the middle of the leaflet.

Watson's name is used in preference to that of Rafinesque on account of the doubtful application of the latter name. Rafinesque's whole description is: "*S. pumilus* Raf. of Oregon mountains, has large edible fruits, eaten and dried by the Shoshonis." Where the "Oregon" mountains may be, and which species of mountain-ash were used by the "Shoshonis", if any species was used at all by the tribe of Indians presumably indicated by that title, is very obscure. If by Oregon mountains is meant the Rockies, and that would coincide with the range of the Shoshone Indians, *Sorbus occidentalis* is definitely excluded since it is not known to occur east of the Cascade Mountains of Washington and Oregon. If *S. occidentalis* was really the species intended, which, as indicated above, is very doubtful, the mention of large fruits is scarcely definitive, since the fruits of that species are not

larger than those of any other western American *Sorbus*. It appears therefore that Rafinesque's name must remain a *nomen dubium*.

Sorbus occidentalis is attributed to California on the basis of a specimen collected in 1937 in the Salmon-Trinity Alps, Siskiyou County, California, by Mr. John Thomas Howell (no. 13519). This specimen is not, however, typical *S. occidentalis;* the inflorescence is somewhat larger, and the leaflets are more serrate than in material from Oregon and Washington. In certain respects it approaches the northern *S. sitchensis*. Additional collections are needed to determine the status of *S. occidentalis* in California.

Hedlund (l. c.) ascribes this species to northeastern Asia and Kamtchatka. However, this is not correct because, as previously noted, *S. occidentalis* is confined to a small area in the western part of North America. Evidently some Asiatic species with oligodontous leaflets has been confused with it. The fact that this species does not occur in Kamtchatka is confirmed by Hultén in his scholarly study of the flora of that region (Svenska Vet.-Akad. Handl. **8**: 49. 1929).

11. **Sorbus sambucifolia** (Cham. & Schlecht.) Roemer, Syn. Mon. **3**: 139. 1847; Hedlund, Svenska Vet.-Akad. Handl. **35**: 37. 1901; Schneider, Ill. Handb. Laubholzk. **1**: 667, *fig. 366 a-b*. 1906; Rehder, Man. Cult. Trees Shrubs 378. 1927; Hultén, Svenska Vet.-Akad. Handl. **8**: 46. 1929; Tatew. & Kobay. Contrib. Fl. Aleutian Isl. 54. 1934; Hultén, Fl. Aleutian Isl. 220. 1937.

Pyrus sambucifolia Cham. & Schlecht. Linnaea **2**: 36. 1827; Torrey & Gray, Fl. N. Am. **1**: 472, 1840.

A shrub 1–2 m. tall; bark gray, smooth; winter-buds glutinous, glossy, slightly rufous pubescent; lenticels few, oval; stipules adnate to the petioles, rufous pilose, membranaceous, lanceolate, deciduous; leaflets 7–11, 3–7 cm. long, lanceolate to ovate-lanceolate or oval, acuminate, usually broadest at the asymmetrical base, dull lustrous green above, paler beneath, soon quite glabrous on both sides; margins sharply serrate almost to the base, the teeth 45–55 on each leaflet; terminal leaflet oval; rachis pilose or glabrate; inflorescence round-topped, 3–5 cm. broad, 8–15-flowered; pedicels and peduncles sparingly rufous pubescent; flowers 1–1.5 cm. in diameter; calyx 5–6 mm. long, the sepals sparingly ciliolate, erect in fruit, rather large, triangular, pubescent within, glabrous on the back; petals oval or roundish 4–5 mm. long; stamens about as long as the petals; styles 5, 1.5 mm. long; top of the ovary pubescent; fruits few, ellipsoid, glaucescent, 1–1.5 cm. in diameter; seeds lanceoloid, symmetrical, dark brown, not flattened, 4 mm. long, 2 mm. wide.

SORBUS ALASKANA G. N. Jones

SORBUS CASCADENSIS G. N. Jones

TYPE LOCALITY: Petropavlovsk, Siberia.

RANGE: Japan and the Commander Islands to Kamtchatka and the westernmost Aleutian Islands.

ALASKA: Attu Isl., August 29, 1891, *J. M. Macoun* (Can, US), *Dall* (G), *Hultén 6112* (G, NY), *6809* (NY).

This is a very distinctive species, not closely related to any other in North America. It occurs in the western hemisphere only on some of the westernmost islands of the Aleutian archipelago, and all the numerous references in botanical literature to *S. sambucifolia,* or *Pyrus sambucifolia,* from continental North America apply to other wholly different species. Hultén (l. c.) reports it to occur on Buldir, Alaid, and Agattu islands as well as Attu.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

STUDIES IN THE LAURACEAE. II[1]
SOME CRITICAL AND NEW SPECIES OF CINNAMOMUM AND NEOCINNAMOMUM

CAROLINE K. ALLEN

Cinnamomum Camphora (L.) Nees & Eberm. Handb. Med. Pharm. Bot. **2**: 430. 1831; Meissner in DC. Prodr. **15**[1]: 24. 1864.

Laurus Camphora Linn. Sp. Pl. 369. 1753.
Camphora officinarum Nees in Wallich, Pl. As. Rar. **2**: 72. 1831.

DISTRIBUTION: tropical Asia and Malaya.

Since the species is so wide-spread and well known, it is unnecessary to include here a citation of specimens.

Cinnamomum Camphora Nees & Eberm. var. **glaucescens** (Braun) Meissner in DC. Prodr. **15**[1]: 24. 1864; Nakai, Bot. Mag. Tokyo **41**: 519. 1927, excl. synon.; Kamikoti, Ann. Rep. Taihoku Bot. Gard. **3**: 79. 1933, "comb. nov."; Ouchi, Sylvia **3**: 125. 1932.[2]

Camphora officinarum var.? *glaucescens* Braun, Verh. Preuss. Gartenb. Ver. **21**: 77. 1852.

DISTRIBUTION: Japan and southeastern China.

CHINA. Fukien: *L. Y. Tai 11473; H. H. Chung 4550; S. T. Dunn 1164* (*H. H. 3485*). Chekiang: *O. Warburg 1887, 6647; Y. Y. Ho 972; S. Chen 197, 2971; R. C. Ching 4790, 5153; H. C. Cheo 14586; Y. L. Keng 402; T. M. Tsui 302.* Kwangtung: *C. O. Levine 399, 661, 3289, 3256, 1269; Y. Tsiang 200; W. Y. Chun 7300.* Hunan: *H. Handel-Mazzetti 591* (*11748*); *W. T. Tsang 23678.*

A portion of Wallich's no. 2604, cited by Meissner in De Candolle's Prodromus as *Cinnamomum Camphora*, from the Meissner herbarium, and now in the New York Botanical Garden, is a fragmentary specimen which apparently at one time had a flower cluster. The odor of this, however, is not strictly a camphor odor, but rather more turpentine-like, which is the description Braun gives for *Camphora officinarum* var.?

[1]Ann. Missouri Bot. Gard. **25**: 361-434. 1938.

[2]Ouchi made *C. camphoroides* Hayata a synonym of var. *glaucescens*. Hayata states that except for its densely flowered terminal branches, *C. camphoroides* resembles *C. Camphora*. Presumably the former yields camphor. Braun says nothing concerning the camphor-yielding quality of the variety *glaucescens*, but comments upon the turpentine-like odor of the leaves. The inflorescence of *C. glaucescens* was not examined, but no specimens at hand having the terebinth odor show a strictly terminal inflorescence. For the present, then, Hayata's species must stand.

glaucescens. Braun states that he has not examined the flowers of the specimen, and is not sure of its value as a species or a variety.

Zollinger no. 2141 from the Meissner herbarium also (fragment at New York), and cited in De Candolle's Prodromus as *C. Camphora glaucescens*, has a distinct camphor odor. Since, as far as can be determined no author has commented on a discrepancy between the publication and the specimens in De Candolle's herbarium, the natural conclusion is that there has been a confusion of labels on the New York specimens. There is another possibility. On the same sheet with Wallich 2604 is a specimen with the label marked "Hort. Bot. Berolin. C. officinarum var.? glaucescens in Herb. Kunth." The specimen has the unmistakable odor of camphor. It is possible that these two labels were reversed in mounting. That, however, does not explain the mislabeling of the specimen called Zollinger 2141. It remains only to await complete examination of the material in the De Candolle herbarium, before a definite conclusion may be reached. As is the case with several species, when in the dried state, the odor seems of doubtful value. It is probable that the odor of the bark is not constant within the species. It has been discovered that some strains of *C. Camphora* do not yield true camphor.[1]

The numbers cited above under the variety *glaucescens*, have the odor which is supposed to be characteristic of the variety, and the leaves are more or less glaucescent on the lower surface.

Cinnamomum nominale Hayata[2] also has been placed under *Cinnamomum Camphora* var. *glaucescens*, but should probably be kept separate, judging from the description. *Cinnamomum nominale* is a shrub, and does not yield camphor. The inflorescence in contrast to that of *C. camphoroides* is loose, few-flowered and axillary. There are other less striking differences revealed upon detailed examination.

Cinnamomum Simondii Lecomte in Nouv. Arch. Mus. Hist. Nat. Paris ser. V, **5**: 73. 1913; Fl. Gén. Indoch. **5**: 111. 1914; Liou, Laurac. Chine Indoch. 26. 1932.

DISTRIBUTION: French Indo-China and western China.

FRENCH INDO-CHINA. Tonkin: *D. Simond 190* (holotype Paris; photo. and fragm. AA). CHINA. Szechuan: *E. H. Wilson 5778*. Kwangsi: *W. T. Tsang 21986*. Yunnan: *A. Henry 11960 B*.

[1]Burkill, Dict. Econ. **1**: 548. 1935.

[2]**Cinnamomum nominale** Hayata, Ic. Pl. Formosa **3**: 160. 1913.
Cinnamomum Camphora nominale Hayata in Matsumura & Hayata, Enum. Pl. Formosa 349. 1906; Jour. Coll. Sci. Tokyo **22**: 349. 1906; Hayata, Ic. Pl. Formosa **6**, suppl.: 62. 1917; Kamikoti, Ann. Rep. Taihoku Bot. Gard. **3**: 78. 1933, "comb. nov."

A species known only from Tonkin and western China. Wilson no. 5778 cited by Gamble[1] as *C. inunctum* does not seem to belong to the latter, but to *C. Simondii*. The leaves are more or less membranous, uniformly ovate, long-acuminate and often falcate, and the inflorescence densely flowered, slender and graceful.

Cinnamomum platyphyllum (Diels), comb. nov.

Machilus platyphylla Diels, Bot. Jahrb. **29**: 348. 1901; Liou, Laurac. Chine Indoch. 50. 1932.

DISTRIBUTION: known only from western China.

CHINA. Szechuan: *C. Bock & A. v. Rosthorn 1981* (holotype of *Machilus platyphylla,* Berlin; isotype, AA); *F. T. Wang 22673*.

This species, as far as the herbarium material which I have examined is concerned, is represented by the type collection and one other specimen. The isotype of *Machilus platyphylla,* so described, is a flowering specimen on which are a few very young fruits. The calyx-lobes are completely caducous, leaving the tube which enlarges to form the small cupule characteristic of the genus *Cinnamomum,* rather than *Machilus*. Wang no. 22673 in fruit is the only specimen which approaches the Bock and Rosthorn specimen, and Wang's plant is without a doubt a *Cinnamomum*. There are a few differences in the leaves of the two specimens. Diel's type has more spreading lateral veins on the whole; is more glaucous on the under surface of the leaves; and the bases of the latter are less auriculate. In every other respect, the two are alike. Since a great deal of leaf variation occurs throughout the family, it seems permissible to consider the two conspecific. The infrutescence[2] is, like the inflorescence, very slender and fragile, the calyx enlarging only slightly to form a small somewhat flaring cupule 2.5–4.0 cm. broad. The fruit is globose, 1 cm., more or less, in diameter.

The species belongs near *C. Bodinieri,* and resembles it in having dense pubescence on the lower surface.

Cinnamomum glanduliferum (Wall.) Nees in Wallich, Pl. As. Rar. **2**: 72. 1831; Meissner in DC. Prodr. **15**[1]: 25. 1864; Hooker f., Fl. Brit. Ind. **5**: 135. 1886.

Laurus glandulifera Wallich, Trans. Soc. Med. Phys. Calcutta **1**: 45, 51, *t. 1.* 1825.

Cinnamomum Cavalerici Lévl., Fedde, Rep. Spec. Nov. **10**: 370. 1912.

Machilus Dominii Lévl., Fedde, Rep. Spec. Nov. **13**: 174. 1914.

[1] Gamble in Sargent, Pl. Wilson. **2**: 68. 1914.

[2] Fructus globosus, 7-9 mm. longus, 1 cm. diam., calyce leviter dilatato discoideo, margine integro.

DISTRIBUTION: southeastern Asia.

INDIA. Nepal: *N. Wallich 2601* (holotype of *Laurus glandulifera*, Kew; photo. and fragm. AA). Burma: *F. G. Dickason 5957*. CHINA. Yunnan: *Delavay 4105; G. Forrest 7506, 7787, 10630, 16517, 17723; H. Handel-Mazzetti 53 (10233); J. F. Rock 8816, 3009; E. E. Maire s.n.* (holotype of *Machilus Dominii*, Edinb.; photo. and fragm. AA); *C. Schneider 2426*. Szechuan: *C. Schneider 606; F. T. Wang 23648*. Kweichow: *J. Cavalerie in Herb. Bodinier 2630; J. Cavalerie 1084* (holotype of *Cinnamomum Cavaleriei*, Edinb.; photo. and fragm. AA). E. Tibet & southwestern China: *G. Forrest 26388*. Hainan: *H. Fung 20161*.

For discussion see *C. Parthenoxylon* below.

Cinnamomum Parthenoxylon (Jack) Nees in Wallich, Pl. As. Rar. **2**: 72. 1831; Meissner in DC. Prodr. **15**[1]: 26. 1864; Hooker f., Fl. Brit. Ind. **5**: 135. 1886.

Laurus glandulifera sensu Jenkins ex Meissner in DC. Prodr. **15**[1]: 26. 1864. Non Wallich.

Laurus Parthenoxylon Jack, Malay. Misc. **1**[5]: 28. 1820; Bot. Misc. **2**: 76. 1830.

Phoebe latifolia Champion, Hooker's Jour. Bot. **5**: 197. 1853.

DISTRIBUTION: southeastern Asia and Malaya.

MALAY PENINSULA. Penang: *N. Wallich 2602* (holotype of *Laurus Parthenoxylon* Kew; photo. and fragm. AA; isotype Gray). INDIA. Hort. Bot. Calcutta, Herb. Jenkins, (specimen in Kew). CHINA. Szechuan: *T. T. Yü 1107*. Kwangsi: *A. N. Steward & H. C. Cheo 591, 781*. Kweichow: *H. Handel-Mazzetti 332 (10970)*. Hunan: *H. Handel-Mazzetti 346 (11059)*. Kwangtung: *C.C.C. 12646; S. K. Lau 2181; Y. Tsiang 2337*. Hainan: *W. Y. Chun 5919, 5957; F. C. How 71851; H. Y. Liang 63486, 64146, 64328, 64830; C. Wang 35093*. Hongkong: *Champion 496* (holotype of *Phoebe latifolia*, Kew; photo. and fragm. AA); *W. Y. Chun 5075, 5078, 6623, 6625; Y. Tsiang 271; Wilford s.n.; C. Wright s.n.*

Cinnamomum Parthenoxylon (Jack) Nees and *C. glanduliferum* (Wall.) Nees have been misinterpreted and interchanged for so many years that it is logical that they should be discussed together. Wallich's List no. 2601 (type of *Laurus glanduliferum*) and 2602 (type of *Laurus Parthenoxylon*) have been photographed and hence are available. From the photographs, however, it is difficult to detect much difference be-

tween the two. The descriptions given by Nees show a difference in inflorescence, that of *C. Parthenoxylon* being terminal and corymbose and foliolate before anthesis; that of *C. glanduliferum* being axillary and paniculate, with the lobes pubescent on the outer surface. The leaves of the former are subtriplinerved, dull on the upper surface, eglandular; of the latter subtrinerved, shining above, bluish grey glaucous below, with glands in the axils of the veins.

The subsequent description by Meissner mentions glands or swollen portions in the axil being sometimes present.

From the descriptions, photos and leaf fragments available, I have made a separation of the two species, with the result that, *C. Parthenoxylon* appears largely in Kwangtung and Hainan, and Malayan islands, while *C. glanduliferum* is confined to India and the Malay Peninsula. The former is more variable in leaf shape, size and venation. The latter seems to be more uniform in all three leaf characters. The fruit of the specimens which I have called *C. Parthenoxylon* is globose, 6–8 mm. in diam., subtended by an enlarged narrowly elongated conical calyx tube 1 cm. or less in length, 1 mm. wide at base to 4 mm. at summit, rugose and longitudinally striate.

The inflorescence of *C. glanduliferum* is less compact that than of *C. Parthenoxylon;* the pedicel is frequently recurved; the fruit globose, about 1 cm. in diam., subtended by an enlarged, elongated calyx-tube, conical in shape, usually less than 1 cm. long, 1 mm. wide at base, flaring at summit to 5 mm. forming a shallow undulating disc.

Cinnamomum Pseudosassafras Meissner has been referred to *C. Parthenoxylon.* I have at hand the type quoted by Hooker[1], *Griffith 623,* from Mergui, which does not seem to belong with *C. Parthenoxylon,* or with any variation of it or with *C. glanduliferum.* Some material from Almora, India matches this very well. More representatives, however, are necessary in order to re-establish *C. Pseudosassafras* as a legitimate species.

Cinnamomum japonicum Sieb. ex Nees, Syst. Laurin. 79. 1836, pro syn.; Nakai, Bot. Mag. Tokyo **41**: 517. 1927; Ouchi, Sylvia **3**: 125. 1932, excl. syn.

Cinnamomum pedunculatum Nees, l. c., pro parte.
Laurus Camphora, in herb. Zuccarini, non Linn.

DISTRIBUTION: Japan, Formosa, Corea, Liukiu Islands.

JAPAN: *Siebold,* in 1842 (possibly isotype of *Laurus Camphora,* Gray Herb.?)

[1]Hooker f., Fl. Brit. Ind. **5**: 135. 1886.

For years, the name *Cinnamomum pedunculatum* has been attached to a variety of specimens from all over southeasterrn Asia. It has not been clear exactly what did comprise the true species. Nakai first established the identity of *Laurus pedunculata* Thunberg, upon which Nees, apparently, without having seen the specimen, based *C. pedunculatum.* The specimen, however, as Nakai states, is *Hedyotis pedunculata* (Thbg.) Nakai. Nees cites *C. japonicum,* a specimen he has seen in Siebold's herbarium, and which he considers conspecific with *Laurus pedunculata.* Meissner, in De Candolle's Prodromus, adds a short description of the flower. The resulting confusion has persisted for almost a century. The following will be an attempt to delineate the species heretofore passing as *C. pedunculatum. Cinnamomum pedunculatum* of Nees, now known as *C. japonicum,* occurs only in Japan, Formosa, Corea and the Liukiu Islands. There are records of misnamed *C. pedunculatum* from China, but these specimens are found to be *C. Burmanni.* The leaves of *C. japonicum* are long-petiolate, and reticulate. The prominence of the reticulations depending on the coriaceous quality of the leaves, or perhaps on the amount of oil present. It is not a stable character, in this species at least. The flowers are arranged in long-pedunculate umbels. The twigs give off a distinct odor of camphor when the bark is scraped. The branches bearing mature fruit are heavier, the leaves larger and more coriaceous, enough so that at first glance they might be thought to be a different species. The Liukiu Island specimens are heavier and larger than the Japanese, but show the same type of fruit. All have some kind of camphor odor, except two specimens; one collected for L. Boehmer in 1904, and the other by E. H. Wilson, no. 8115. These two have a sweetish odor. Again this may be due to circumstance of growth, or it may be that this is indeed another strain with the fragrant essential oil predominant. Since there are only two of this type at hand, no further disposition of them is made, than the mention of the difference in odor. There is a group of plants collected in Corea, which show differences from the Japanese *C. japonicum.* They are coarser, heavier plants, even in the flowering stage, the leaves vary in shape and have a tendency to become acuminate. Perhaps this group belongs near *C. osmophloeum* Kanehira, but it is difficult to say definitely without more material of the latter. The leaves are smaller than in the latter species; are usually less coriaceous and are reticulate in the manner of *C. japonicum.* The twigs have a mixed champhor and spice odor, and are shining red-brown. These have been placed for the time being under *C. japonicum.*

Another species belonging in the *C. japonicum* group is *C. Sieboldii*

Meissner. The leaves are not reticulate; they are ovate to lanceolate-oblong, coriaceous and glaucous on the lower surface. The inflorescence, which is strikingly different from that of the former, is composed of numerous slender, axillary, subumbellate racemes, with large glabrous flowers on very slender, long pedicels. This species occurs in Japan only.

Cinnamomum Burmanni (Nees) Blume, Bijdr. 569. 1825; Hooker f., Fl. Brit. Ind. **5**: 136. 1886; Chun, Contr. Biol. Lab. Sci. Soc. China **1**[5]: 13. 1925; Liou, Laurac. Chine Indoch. 33. 1932.

Laurus dulcis Roxburgh, Hort. Bengal. 30. 1814, nom. nud.; Wallich, List No. 2581B. 1830, nom. nud.; Roxburgh, Fl. Ind. **2**: 303. 1832.
Laurus Burmanni C. G. & T. F. L. Nees, Disput. Cinn. 57, *t. 4*. 1823.
Cinnamomum dulce Nees in Wallich, Pl. As. Rar. **2**: 75. 1831.
Cinnamomum chinense Blume, l. c.

DISTRIBUTION: southeastern Asia and Malaya.

CHINA: Hainan: *W. Y. Chun 5865, 5943; N. K. Chun & C. L. Tso 44280, 44323, 44338; H. Fung 20173, 20381; F. C. How 71377, 71876; H. Y. Liang 64447, 64448, 64513, 65124; W. T. Tsang 82, 498; C. Wang 34284, 34584, 35013, 36164.* Kwangtung: *C. O. Levine & G. W. Groff 136; T. K. Ping 10974; Y. Tsiang 1786; C. L. Tso 21466; C. L. Tso & Y. Tsiang 2042; T. M. Tsui 40.* Kwangsi: *A. N. Steward & H. C. Cheo 281.* FRENCH INDO-CHINA. Annam: *A. Chevalier 41220.* INDIA: *N. Wallich 2581B* (syntype of *Laurus dulcis* Roxb., isotype Kew; photo. and fragm. AA).

Numerous specimens from Hainan and Kwangtung as well as other provinces of China have been placed under *Cinnamomum pedunculatum* Nees, which is now known as *C. japonicum Sieb.* These are not *C. japonicum* but belong under *C. Burmanni* Bl. The odor of the young stems is that of a very sweet sandal-wood. That of the bark is distinctly cinnamon-like. It has been known for centuries that different portions of the tree, as Loureiro mentions in a discussion of *Laurus Cinnamomum*[1] yield oil of different qualities.

The specimens cited below are similar in every respect to *C. Burmanni,* but the odor is not that of cinnamon or camphor, but a mixture of both. Here is a problem which may be one of those brought up when hybrids are formed naturally or through cultivation; or the group of plants under discussion may be a different strain of the same species. It is an interesting fact that these specimens, when the bark of the twigs is first scraped, give a disagreeable camphor-spice odor, which, after

[1]Loureiro, Fl. Cochinch. 1: 249. 1790; ed. 2. 309. 1793.

several minutes, becomes delicately spicy. This would indicate definitely the presence of two elements in the bark; one the oil of camphor, which is extremely volatile; the other, the oil of cinnamon, which is more inert. For the present, these specimens are not separated even as variety, but attention is called to this point. The majority of these plants occur in Kwangtung. It is interesting to note from field labels, that the colloquial name given to this plant in Kwangtung is "False Cinnamon Tree".[1]

China. Hainan: *W. Y. Chun 118, 7327, 30427, 30524; C. Ford, s.n.; S. K. Lau 788, 2706; S. P. Ko 52121; C. O. Levine 173, 343, 400, 449, 969; F. A. McClure 7956; K. P. To & Y. Tsiang 12961; W. T. Tsang 32; C. L. Tso 21479; C. Wang 407.* Fukien: *H. H. Chung 1329, 1658, 8427.* Hupeh: *H. C. Chow 48.*

That a great variation occurs in this species can be ascertained by glancing through the specimens represented under the species. Liou, from the Indochinese material alone has separated four varieties, α, β, γ and δ, on leaf texture and pedicel length, for the most part. Since the species occurs in such profusion, not only in Indochina but in other parts of tropical Asia and Malaya as well, and is widely cultivated, it is not unreasonable to suppose that hybridization has produced many variants. Only the one variety following is recognized by the author.

Cinnamomum Burmanni Blume var. **angustifolium** (Hemsl.), comb. nov.

Cinnamomum pedunculatum Nees var. *angustifolium* Hemsley, Jour. Linn. Soc. Bot. **26**: 373. 1891; Chun, Contr. Biol. Lab. Sci. Soc. China **1**[5]: 14. 1925; Liou, Laurac. Chine Indoch. 37. 1932; Allen, Jour. Arnold Arb. **17**: 325. 1936.

Cinnamomum linearifolium Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V, **5**: 79. 1913; Liou, Laurac. Chine Indoch. 32. 1932.

?*Laurus Heyneana* Wallich, List No. 2576. 1930, nom. nud.

?*Cinnamomum Heyneanum* Nees in Wallich, Pl. As. Rar. **2**: 76. 1831; Hooker f., Fl. Brit. Ind. **5**: 136. 1886.

Distribution: southern Asia.

China. Kweichow: *J. Cavalerie 3082* (holotype of *C. linearifolium*, Paris; isotype, NY; photo. AA). Szechuan: *E. Faber 575* (syntype of *C. pedunculatum* var. *angustifolium*, Kew; isotype, NY; photo. AA). Hupeh: *A. Henry 1193, 1353* (syntypes of *C. pedunculatum* var. *angustifolium*, Kew; isotypes, Gray); *A. Henry 1293, 2759, 3466, 3881* (syntypes of *C. pedunculatum* var. *angustifolium* not seen, Kew). India: *N. Wallich 2576* (iso-holotype of *Laurus Heyneana*, Kew; photo. AA).

[1]Burkill, Dict. Econ. **1**: 546. 1935.

The variety does not in any way resemble what has been known as *C. pedunculatum* now known as *C. japonicum*. Although a photograph only of a sterile branch of *Laurus Heyneana* Wall. is available, it seems probable that this is the same as *C. Burmanni angustifolium*.

Cinnamomum Loureirii Nees, Syst. Laurin. 65. 1836 (based on *Laurus Cinnamomum*); Meissner in DC. Prodr. **15**[1]: 16. 1864; Lecomte, Not. Syst. **2**: 336. 1913; Nouv. Arch. Mus. Hist. Nat. Paris sér. V, **5**: 80. 1913; Merrill, Trans. Am. Phil. Soc. **14**[2]: 164. (Comm. Loureiro Fl. Cochinch.) 1935.

Laurus Cinnamomum sensu Loureiro, Fl. Cochinch. 249. 1790; ed. 2. 309. 1793, non Linn.

Cinnamomum obtusifolium Nees var. *Loureirii* Perr. & Eberh., Bull. Sci. Pharm. **16**: 574, *t. 3*. 1909; Burkill, Dict. Econ. **1**: 553. 1935.

DISTRIBUTION: French Indo-China.

FRENCH INDO-CHINA. Annam: *J. & M. S. Clemens 3523*. Tonkin: *A. Petelot 1949*.

This is a much disputed species, since there is no extant type. The material which seems to answer the description given by Loureiro, comes from near the type locality in Indochina. It has a sweet sandal-wood odor. Loureiro mentions the fact that it is fairly rare, which is certainly true, if one can judge from the scarcity of herbarium specimens. The *Cinnamomum Loureirii* from Japan cited by Nees, bears no resemblance to the Indochinese specimens that conform to Loureiro's original description. The Japanese specimens have a sweet spicy odor. It would seem that Nees has merged under one name two distinct entities, and that the true *C. Loureirii* as Merrill[1] suggests should refer to Loureiro's specimen and not to the Japanese plant. Thus the Japanese plant should have another name.

At this point it seems pertinent to discuss the so-called Saigon cinnamon used commercially, and described by O. A. Farwell from the bark alone as *Camphorina saigonensis*.[2] As Merrill[3] commented in his discussion on the subject, the commercial cinnamon must necessarily be a wide-spread species, hence it cannot have escaped the notice of collectors and taxonomists for all of these years. Chevalier believes that it is either purchased from Chinese or Annamese merchants and thus brought into the port of Saigon, or else it is furnished by *C. Loureirii*. This latter belief would indicate that *C. Loureirii* is a wide-spread species, a fact belied by the scarcity of herbarium specimens. Dr. Heber W.

[1]Merrill in Trans. Am. Phil. Soc. **14**[2]: 164 (Comm. Loureiro Fl. Cochinch.). 1935.
[2]O. A. Farwell, Druggists Circular **62**: 535. 1918.
[3]Merrill, Bot. Gaz. **70**: 84. 1920.

Youngken of the Massachusetts College of Pharmacy, of Boston, very kindly examined a specimen of bark sent by Park, Davis Co., the so-called Saigon cinnamon of commerce. This he announced to be different microscopically from the *Cinnamomum Loureirii* bark with which he is familiar. At the same time, he examined the bark of *C. Burmanni* which has been mislabeled *C. pedunculatum*. The latter species is wide-spread, with a definite cinnamon odor. It was thought that this might be the Saigon cinnamon. Dr. Youngken, however, stated that it in no way resembled the latter microscopically. It is possible that since there has been such a demand for the product, and the tree has been cultivated for so many years, that there is a great deal of hybridization between the various strains. This fact might account very reasonably for the difference in structure of the bark as shown on microscopic examination. Thus *Cinnamomum Burmanni* seems to be the most logical species to assume as being the one which Farwell used in his description. Unless we accept this, we are no nearer the solution of its identity than we were at the outset. Farwell most curiously based his new binomial strictly on a bark specimen from commercial sources.

Cinnamomum Tamala Nees & Eberm. Handb. Med. Pharm. Bot. **2**: 426. 1831; Nees in Wallich, Pl. As. Rar. **2**: 75. 1831; Meissner in DC. Prodr. **15**[1]: 17. 1864; Hooker f., Fl. Brit. Ind. **5**: 128. 1886; Hemsley, Jour. Linn. Soc. Bot. **26**: 373. 1891; Chun, Contr. Biol. Lab. Sci. Soc. China **1**[3]: 14. 1925; Liou, Laurac. Chine Indoch. 34. 1932.

Laurus Cassia Wallich, List No. 2580B. 1830, nom. nud.

Laurus albiflora Wallich, List No. 2569A. 1830, nom. nud.

Cinnamomum albiflorum Nees in Wallich, Pl. As. Rar. **2**: 75. 1831; **3**: 36. 1832; Syst. Laurin. 58. 1836; Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V, **5**: 75. 1913; Fl. Gén. Indoch. **5**: 113. 1914; Liou, Laurac. Chine Indoch. 34. 1932.

Cinnamomum Tamala Nees var. *albiflorum* Meissner in DC. Prodr. **15**[1]: 18. 1864; Liou, Laurac. Chine Indoch. 34. 1932, pro syn.

DISTRIBUTION: southeastern Asia.

INDIA. Silhet: *N. Wallich 2580B* (iso-holotype of *Laurus Cassia*, Kew; photo. AA). Nepal: *N. Wallich 2569 A* (iso syntype of *Laurus albiflora*, Kew; photo. AA).

Since Nees' time *Cinnamomum Tamala* and *C. albiflorum* have been confused. Meissner in 1864 made *C. albiflorum* a variety of *C. Tamala*. Hooker in 1886 reduced *C. albiflorum* to synonymy under *C. Tamala*. Lecomte re-established the former as a species. The reasons he gave, however, are the differences in the inflorescences of the two and in the leaves. These differences, in view of considering the species a wide-

spread entity instead of a localized one, become not specific in their importance but rather fall into place as local variations of a single species. Lecomte has mentioned the fact that the lobes of the corolla are completely caducous in *C. Tamala* and incompletely so, forming the truncate margin of the fruit cupule in *C. albiflorum*. The specimens at hand do not show this.

Near *C. Tamala* is, according to Parker[1], *C. cacharense* from India, the difference being that the latter species has more slender panicles, smaller flowers with relatively broader perianth lobes, which are completely deciduous in fruit, leaving the cup with an entire margin. The margin in *C. Tamala* is truncated at the base from the cupule.

Cinnamomum Wilsonii Gamble in Sargent, Pl. Wilson. **2**: 66. 1914; Chun, Contr. Biol. Lab. Sci. Soc. China **1**[5]: 15. 1925; Liou, Laurac. Chine Indoch. 30. 1932.

Cinnamomum Wilsonii var. *multiflorum* Gamble in Sargent, Pl. Wilson. 2: 67. 1914; Liou, Laurac. Chine Indoch. 30. 1932.

Distribution: central China.

China. Hupeh: *E. H. Wilson 2003, 2098, 2227, 5183* (syntypes of *Cinnamomum Wilsonii*, AA); *E. H. Wilson 3712* (holotype of *Cinnamomum Wilsonii* var. *multiflorum*, AA).

Regarding *C. Wilsonii* and its variety it might be well to mention a difficulty which arose while they were being studied. The distinctions which Gamble noted as separating the variety from the species do not prove to be constant for the numbers mentioned. Wilson no. 2227, for example, is certainly nearer the variety than the species. It is possible, however, that the labels for the two numbers were interchanged in handling.

Cinnamomum Jensenianum Handel-Mazzetti, Anz. Akad. Wiss. Wien Math.-Nat. **1921**: 63 (Pl. Nov. Sin. Forts. **10**: 1); Symb. Sin. **7**[1]: 249. 1931; Liou, Laurac. Chine Indoch. 39. 1932.

Distribution: central China.

China. Hunan: *H. Handel-Mazzetti 12287* (holotype of *Cinnamomum Jensenianum*, Vienna; isotype, AA).

Cinnamomum Lioui, spec. nov.

Cinnamomum albiflorum Nees var. *kwangtungensis* Liou, Laurac. Chine Indoch. 35. 1932.

Arbor 13 m. alta, ramis fuscis teretibus, odore camphorae, glabrescentibus vel glabris, ramulis subangulatis pubescentia brevi adpressa pallide fusca tectis. Folia elliptica, 4–6 cm. longa, 1.5–2.3 cm. lata,

[1]Parker in Fedde, Rep. Spec. Nov. 31: 126. 1932.

supra opaca, subtus pallida, subcoriacea, acutissime acuminata, cuneata, subtus nervis sparse pubescentibus exceptis glabra, 3-pli-nervia, nervis supra inconspicuis subtus prominentibus, circa 4 mm. supra basin laminae divergentibus, lamina plerumque sensim in petiolum attenuata, petiolo circa 1 cm. longo, tenui pubescente. Inflorescentia axillaris et subterminalis, paniculato-cymosa, foliis longior, 6–10 cm. longa, subflavo-cana, pubescens, axi primario paniculata ramulorum paribus 2–3, axibus II-III ordinis cymosis, ultimis cymulis 3-vel rarius 2-floris; pedunculo ad 5.5 cm. longo, pedunculis 2ndi ordinis apicem versus decrescentibus, infimis circa 12 mm. longis; pedicellis 2–3 mm. longis. Flores subviridi-cani, 3–4 mm. longi, lobis 6 ad 3 mm. longis ovatis obtusis, 3 exterioribus quam interiora brevioribus, staminibus 9, 2 mm. longis, antheris oblongis filamenta aequantibus, filamentis in facie posteriore sparse pubescentibus, 6 introrsis, 3 interioribus biglandulosis extrorsis, staminodiis 3 cordatis stipitatis, stipite in facie posteriore pubescente; stylo quam ovarium ovoideum triente longiore; stigmate orbiculari in apice styli lateraliter posito. Fructus ignotus.

DISTRIBUTION: Kwangtung.

CHINA. K w a n g t u n g : Lok Chong, *C. L. Tso 20807*, May 28, 1929, tree 13 m. high, diam. 50 cm. (holotype of *C. albiflorum* var. *kwangtungensis*, NY).

Liou described this specimen as a variety of *C. albiflorum*.[1] It does not seem to be very closely related to the latter, but to be worthy of specific rank. Since there is already a *C. kwantungense* it is named after Liou, author of the variety and a monographer of the family. *Cinnamomum Lioui* has a slender graceful flowering branch as compared with the rather stiff inflorescence of *C. albiflorum*. The leaves of the latter are 10–11 cm. in length and the flowers measure 5–6 mm. long, in contrast to the leaves of *C. Lioui*, which are 6 cm. long at most, and to the flowers which are never more than 3.5 mm. long. The inflorescence of *C. Lioui* projects several centimeters beyond the leaves, whereas that of *C. albiflorum* is rarely even with the leaves. *Cinnamomum Lioui* has a camphor-like odor whereas *C. albiflorum* has a faint delicate perfume.

Cinnamomum tonkinense (Lecomte) A. Chevalier, Bull. Econ. Indoch. **21**: 856. 1918.

Cinnamomum albiflorum Nees var. *tonkinensis* Lecomte, Fl. Gén. Indoch. **5**: 115. 1914.

DISTRIBUTION: known only from type locality.

[1] *Cinnamomum albiflorum* Nees is now a synonym of *C. Tamala* Nees & Eberm.

FRENCH INDO-CHINA. Tonkin: *Balansa s.n.* (holotype of *C. albiflorum* var. *tonkinensis,* Paris; photo. AA).

This species has smaller leaves, more definitely lanceolate and short panicles not exceeding 4 cm., axillary only, and not borne near the summit of the branches. In respect to the position of the inflorescence, the species is similar to those specimens of *C. Wilsonii* which occur in central China. It is doubtful whether *C. tonkinensis,* in view of the previous discussion, is worthy of specific rank. More abundant material from Indochina will aid in this decision.

Cinnamomum Cassia (Nees) Nees & Eberm. ex Blume, Bijdr. 570. 1825; Handb. Med. Pharm. Bot. **2**: 424. 1831; Meissner in DC. Prodr. **15**[1]: 12. 1864; Hooker f., Fl. Brit. Ind. **5**: 130. 1886; Lecomte, Fl. Gén. Indoch. **5**: 116, *fig. 11.* 1914; Chun, Contr. Biol. Lab. Sci. Soc. China **1**[5]: 13. 1925; Liou, Laurac. Chine Indoch. 28. 1932.

Laurus Cassia C. G. & T. F. L. Nees, Cinn. Disput. 53. *t. 3.* 1823, excl. syn. pl.

Cinnamomum aromaticum Nees in Wallich, Pl. As. Rar. **2**: 74. 1831.

DISTRIBUTION: China? Cultivated in all tropical Asia and Malaya.

BRITISH INDIA. Malabar: *?Rheede s. n.* (syntype of *Laurus Cassia,* Leiden? not seen.) CHINA. Kwangtung: *W. T. Tsang 1201.* Kwangsi: *R. C. Ching 8289.*

This species also, has been confused with the so-called *C. pedunculatum,* or *C. Burmanni. Cinnamomum Cassia* is easily distinguished. First, by the very strong odor of pure spice, unadulterated by any other element; second, by the extremely large leaves, shining above, with veins very prominent below; the large spreading inflorescence, and finally the calyx enlarging to form a deep cupule with a scalloped margin. There are very few specimens known thus far from China.

I have at hand a photograph of *Cinnamomum Cassia* agreeing with the illustration of Nees' publication of 1823. Apparently the photograph is of an authentic specimen from Blume's herbarium. Blume presumably had access to the *Laurus Cassia* of Nees, but Nees mentions three specimens, Rheede's from British India, Loureiro's from Cochinchina which refers to *C. Loureirii,* and Viery's from Sumatra. Which of these is represented by the photograph is impossible to determine, without consulting Blume's herbarium.

Cinnamomum ovatum, spec. nov.

Arbor 22 m. alta, ramis glabris teretibus striatis, odore diluto-aromatico, ramulis glabris subangulatis. Folia ovata, 4–8 cm. longa,

2.5–4.5 cm. lata, viridia, supra nitida, obtusa vel acuta, glabra, 3-pli-nervia, nervis supra basim laminae varie divergentibus, inconspicue reticulata, petiolo 1–2 cm. longo, glabro. Inflorescentia subterminalis vel axillaris cymosa subumbellata, 4–6 cm. longa, pubescentia sparse adpressa, 3-ramis, ramo centrali unifloro, ramis 2 lateralibus 2–3-floris, pedicellis 6–10 mm. Flores ignoti. Calyx dilatatus margine integro vel undulato, fructum immaturum includens.

DISTRIBUTION: Hainan.

CHINA. H a i n a n : Dung Ka to Wen Fa, alt. 1700 ft. 1932-33, tree 22 m. high, diam. 50 cm., *N. K. Chun & C. L. Tso 43739* (AA).

This species is similar in habit to *C. Burmanni,* the difference being in the ovate leaves and the fruit cupule which is entire. In leaf shape it resembles *C. Caryophyllus* (Lour.) Moore. Until flowering material is collected, no further comparison can be made. The characters exhibited by the fruiting specimen place it without doubt in the genus *Cinnamomum.* Such striking characters as the above mentioned warrant a description on the fruiting specimen alone.

Cinnamomum Tsoi, spec. nov.

Arbor 12 m. alta, ramis teretibus glabris, odore aromatico terebinthino, ramulis teretibus, maturitate tomento fusco adpresso brevi crispo sparse tectis. Folia elliptico-lanceolata, 7–11 cm. longa, 1.5–3.5 cm. lata, fusco-viridia, coriacea, acuminata, basi cuneata, supra glabra, subtus pubescentia crispa sparsa, 3-pli-nervia, subtus nervis valde prominentibus, nervis lateralibus ad marginem ramosis, petiolo 6–10 mm. longo maturitate glabro. Inflorescentia subterminalis vel axillaris paniculata, fere adpresse tomentosa. Flores ignoti; Fructus ellipsoideus, apiculatus, 1.5 cm. longus, minus quam 1 cm. in diam., glaber, cupula lignea circa 0.5 cm. longa margine integro subtentus.

DISTRIBUTION: Hainan.

CHINA. H a i n a n : Fan Yah, alt. 2400 ft., *N. K. Chun & C. L. Tso 44128,* 1932-33, tree 12 m. high, diam. 45 cm. (AA).

Superficially the species is similar to the following species, but differs in the type of inflorescence and pubescence, and the odor of the bark.

Cinnamomum Merrillianum, spec. nov.

Frutex 1 m. altus, ramis glabrescentibus vel glabris teretibus, odore acri aromatico, ramulis teretibus, pubescentia densa argenteo-sericea mox fuscescente et evanida tectis. Folia oblongo-lanceolata, 6–10 cm. longa, 1.5–2.3 cm. lata fusco-viridia, coriacea, attenuato-acuminata, basi rotundata ad cuneata, folia nova supra argenteo-sericea, matura

glabra, subtus pallide fusco-sericea, mox glabra, 3-pli-nervia nervis subtus valde prominentibus pubescentia primo argentea, mox subrufo-fusca, venis transversis obscuris, petiolo 5–12 cm. longo primo pubescente mox glabrescente vel glabro. Inflorescentia axillaris cymosa 1–3-flora, argenteo-sericea; pedunculis 0.5–2.5 cm. longis, pedicellis 3.5–5 mm. longis. Flores viridi-cani 3–4 mm. longi, lobis 6 ovatis 2 mm. longis intus strigosis; staminibus 9 circa 1 cm. longis, in facie posteriore pubescentibus, 3 interioribus biglandulosis extrorsis, glandulis stipitatis; staminodiis 3 triangularibus; ovario oblongo-ovoideo glabro 1 mm. longo, stylo gracili 1.5 mm. longo, stigmate obscure trilobato. Fructus ignotus.

DISTRIBUTION: Hainan.

CHINA. H a i n a n : *H. Y. Liang 63752,* Oct. 23, 1933, shrub 1 m., on mountain top, (AA).

A striking species, with silvery pubescence completely covering the young branchlets and inflorescence. *Cinnamomum Merrillianum* in leaf shape and pubescence resembles *C. Chingii,* but the inflorescence is few flowered, much shorter, never exceeding 2 cm. in length, and the leaves are smaller and narrower.

Cinnamomum Liangii, spec. nov.

Arbor plus quam 19 m. alta, ramis glabris teretibus striatis, odore suavi-aromatico, ramulis glabris angulatis. Folia elliptico-lanceolata, 6–13 cm. longa, 2.4–4 cm. lata, fusco-viridia, membranacea, acuminata, acuta vel fere rotundata, glabrata, 3-pli-nervia, nervis fulvis, supra basim laminae varie divergentibus, petiolo 5–7 mm. longo glabro. Inflorescentia subterminalis vel in ramulis brevibus lateralibus, simpliciter racemosa, 3–7 cm. longa, pedicellis 3–5 mm. longis. Flores ignoti. Fructus ellipsoideus, apiculatus, ad 1.3 cm. longus, 7–8 cm. diam., glaber, cupula brevi ad 3 cm. longa irregulariter crenulata glabra subtentus.

DISTRIBUTION: Hainan.

CHINA. H a i n a n : Seven Finger Mt., *H. Y. Liang 61708,* April 30, 1932, tree 19 m. high, diam. 4 m. (AA).

A species resembling *C. graciliflorum* Gamble from India as nearly as can be told from the photographs of the latter. The cupule of *C. Liangii,* however, is more shallow and the leaves less long-acuminate.

Cinnamomum curvifolium (Lour.) Nees, Syst. Laurin. 80. 1836; Meissner in DC. Prodr. **15**[1]: 23. 1864; Merrill, Trans. Am. Phil. Soc. **24**[2]: 163 (Comment. Loureiro Fl. Cochinch.) 1935, pro parte.

Laurus curvifolia Lour. Fl. Cochinch. 252. 1790, ed. 2. 309. 1793.
Laurus pauciflora Wallich, List No. 2579. 1830, nom. nud.
Cinnamomum pauciflorum Nees in Wallich, Pl. As. Rar. **2**: 75. 1831; Hooker f., Fl. Brit. Ind. **5**: 129. 1886.
Laurus recurvata Roxburgh, Hort. Bengal. 30. 1814, nom. nud; Fl. Ind. **2**: 301. 1832.
Cinnamomum recurvatum Wight, Ic. *t. 133*. 1839.

DISTRIBUTION: southeastern Asia.

INDIA. Silhet: *N. Wallich 2579* (iso-holotype of *Laurus pauciflorum*, Kew; Gray). CHINA. ?(type of *Laurus recurvata* mentioned by Roxburgh without number or locality.)

Point for point, in his description of *Laurus curvifolia*, Loureiro has described a *Cinnamomum*, until two lines from the last: "ibique illorum quodlibet e 4 foraminibus emittens 4 filamenta tenuissima antherulis totidem, oblongis, 2-locularibus." The only discrepancy appears to be the "2-locularibus." Since it has been shown by Merrill in his Commentary on Loureiro's Flora, that Loureiro's descriptions are not always accurate, and since in every other respect the plant is a *Cinnamomum*, it may without hesitation be placed under that genus. Merrill has reduced *C. albiflorum* to *C. curvifolium*. The leaves of the former are not reflexed or incurved; nor are they obsoletely 3-nerved. The racemes are large rather than small. On the other hand, the leaves of *C. pauciflorum* or *C. recurvatum* are not obsoletely 3-nerved and they are opposite or nearly so. The description of *L. curvifolia*, however, seems to point toward the last two mentioned species.

Cinnamomum Appelianum Schewe in Handel-Mazzetti in Anz. Akad. Wiss. Wien. Math.-Nat. 1924: 20 (Pl. Nov. Sin. Forts. **24**: 1); Symb. Sin. **7**[1]: 250. 1931; Liou, Laurac. Chine Indoch. 30. 1932.

DISTRIBUTION: central and western China.

CHINA. Hunan: *T. H. Wang* (*Handel-Mazzetti 75*) (holotype, Vienna; isotype, AA). Kwangsi: *W. T. Tsang 28283; T. S. Tsoong 81565.*

Handel-Mazzetti notes a similarity to *C. Bonii* Lecomte from Tonkin, in the indument, but comments on the difference in length of panicles and the inflorescence.

Cinnamomum Tsangii Merrill, Lingnan Jour. Sci. **13**: 26. 1934.

DISTRIBUTION: known only from type locality.

CHINA. Kwangtung: *W. T. Tsang 20439* (holotype, NY; photo. and fragm. AA).

The similarity between this species and the preceding one is so

marked that I feel sure they are the same. I am keeping them distinct for the reason that the material is scant and the localities rather far apart. That, however, will be remedied with more abundant material, I feel sure. The only difference which I can discover is the presence in *C. Appelianum* of numerous well-defined lateral veinlets extending from the two main laterals upward towards the midrib. The venation is scarcely noticeable on the upper surface, but very prominent below. These lateral veinlets are lacking in *C. Tsangii,* except in one case where there is a suggestion of one lateral veinlet towards the base of the leaf. In the latter, the laterals join the midrib nearer the base than in *C. Appelianum.* The fact that *C. Tsangii* is represented by fruiting specimen only and the type of *C. Appelianum* is in flower, does not obscure the fact that the two are close. In fact, the type inflorescence of both species is unique in the genus, since it is short, axillary and rather stiff. The only other species which approaches it in this respect is *C. curvifolium.*

Cinnamomum pittosporoides Handel-Mazzetti, Anz. Akad. Wiss. Wien. Math.-Nat. 1924: 19 (Pl. Nov. Sin. Forts. **24**: 1); Symb. Sin. **7**[1]: 248. 1931; Liou, Laurac. Chine Indoch. 32. 1932.

DISTRIBUTION: known only from Yunnan.

CHINA. Yunnan: *Handel-Mazzetti 6245* (holotype, Vienna; isotype, AA); *Simeon Ten 402.*

Handel-Mazzetti has drawn attention in the Symbolae Sinicae to the unusual characteristics of the above species. The fact that the inner cycle of stamens has the two top locules in a lateral position as compared with the two lower locules, is not a very strong character, he points out, since other members of the genus have this also. Many times a freak twisting of the anther causes one or the other pair of anthers to appear lateral, but they are still in two planes, which is not the case of the truly lateral locules found only in *Neocinnamomum.* The flower structure of Handel-Mazzetti's species except for the unusual anthers of the third cycle of stamens is typically that of *Cinnamomum.* The fruit, however, which hitherto has been undescribed, is larger than that of any known *Cinnamomum,* being 2.5–3 cm. long by 2 cm. broad, ellipsoid-ovoid, falcate, the surface coarsely rugose, apiculate, attenuate at the base and subtended by an enlarged ligneous coriaceous calyx, somewhat fluted and slightly reflexed. The pericarp of the fruit is woody, several millimeters in thickness, at base and apex, and of varying thickness elsewhere. The fruit is not typical *Cinnamomum,* but since the floral parts are, the species is left in that genus.

Cinnamomum iners Reinwardt ex Blume, Bijdr. 570. 1825; Nees in Wallich, Pl. As. Rar. **2**: 73. 1831; Meissner in DC. Prodr. **15**[1]: 19. 1864; Hooker f., Fl. Brit. Ind. **5**: 130. 1886; Lecomte, Fl. Gén. Indoch. **5**: 116. 1914; Liou, Laurac. Chine Indoch. 30. 1932.

Laurus Malabathrum Wallich, List No. 2583A. 1830, ex parte, nom. nud.
Laurus iners Reinwardt ex Nees in Wallich, Pl. As. Rar. **2**: 73. 1831, pro synon. praecedentis.

DISTRIBUTION: Malaysia, Ceylon and the Malay Peninsula.

JAVA: *Blume?* (holotype? of *Laurus iners*, Leiden; photo. AA), *N. Wallich no. 2583A*, ex parte (isotype of *Laurus Malabathrum*, Kew; photo. AA).

Cinnamomum obtusifolium Nees in Wallich, Pl. As. Rar. **2**: 73. 1831; Syst. Laurin. 33. 1836; Meissner in DC. Prodr. **15**[1]: 12. 1864; Hooker f., Fl. Brit. Ind. **5**: 128. 1886; Lecomte, Fl. Gén. Indoch. **5**: 115. 1914.

Laurus obtusifolia Roxburgh, Hort. Bengal. 30. 1814, nom. nud.
Laurus obtusifolia Wallich, List No. 2574A, C. 1830, nom. nud.

DISTRIBUTION: India and China.

INDIA. Silhet: *N. Wallich 2574A* (iso-syntype, Kew; AA); *N. Wallich 2574C* (iso-syntype not seen, Kew). CHINA. Yunnan: *A. Henry 10440, 12819; C. Wang 75287, 77253, 77370.* Hainan: *F. C. How 72078; S. K. Lau 3573; H. Y. Liang 64620, 64951, 65328; C. Wang 36576, 36175.*

The two last mentioned species should be considered together, since there has been a great deal of confusion between them. *Cinnamomum iners* is found in Malaysia in great abundance, in Ceylon and the Malay Peninsula, whereas *Cinnamomum obtusifolium* thus far is reported only from India and China.

The leaves of *C. iners* are frequently pubescent on the lower surface. In *C. obtusifolium* they are glabrous or glabrescent, and are larger and much coarser in texture than those of the former. The greatest difference, however, occurs in the inflorescence. *Cinnamomum iners* has axillary and subterminal panicles, for the most part not exceeding the leaves, while in *C. obtusifolium* the very numerous panicles are usually subterminal, and usually exceed the leaves. The flowers of *C. iners* are small, the lobes are triangularly ovate, nearly as broad as long, with dense sericeous pubescence, completely covering the outer surface. The flowers of *C. obtusifolium* are much larger, the lobes ovate, longer than broad, with sparse short grayish pubescence, the tips of the lobes nearly glabrous. The peduncles of the inflorescence of

C. obtusifolium are heavier and coarser than those of *C. iners*. The fruit of *C. iners* is up to 8 cm. long, ellipsoid, acutish at apex, apiculate. The calyx-lobes are slightly enlarged, persistent and spreading. The fruit of *C. obtusifolium* measures about 1 cm. in length, is oblong-ellipsoid, rounded at apex and apiculate. The calyx-lobes are considerably enlarged, caducous at the midpoint, the remainder forming a shallow cupule with deeply scalloped margin.

Cinnamomum Fargesii Lecomte in Nouv. Arch. Mus. Hist. Nat. Paris, sér. V, **5**: 78. 1913; Liou, Laurac. Chine Indoch. 40. 1932.

Distribution: known only from type locality.

China. Szechuan: *P. Farges 1064* (holotype, Paris; photo. and fragm. AA).

A species apparently transitional between *Cinnamomum* and *Neocinnamomum*. The flowers definitely show the structure of the former, while the leaves recall those of the latter genus. The fruit, as yet, is unknown (see discussion below under *Neocinnamomum*).

Neocinnamomum Liou, Laurac. Chine Indoch. 82. 1932.

The question has arisen recently of whether or not Liou's generic segregate from *Cinnamomum* should stand. With the exception of one little-known species, i.e. *C. Fargesii*, the line of demarcation is clear cut.

The members of *Neocinnamomum* have leaves that are tri- or triplinerved; the inflorescences are pedunculate or consisting of sessile glomerules crowded into leaf axils; the flowers are unisexual, with nine fertile stamens with anthers having four cells, all in the same plane. Other differences mentioned by Liou, and apparent on examination, mark the genus. The most important, however, is the plane of the cells. Some species of the genus have heretofore been confused with *Cinnamomum Fargesii* and with *Lindera*.

Neocinnamomum hainanianum, spec. nov.

Frutex 3 m. altus, ramulis brunneo-pubescentibus teretibus striatis. Folia alterna, membranacea, late ovata, 8–10 cm. longa, 4–7 cm. lata, acuminata, basi cuneata subtruncatave, supra venis exceptis glabriuscula, subtus brunneo-pubescentia, subtriplinervia, petiolis 1–1.5 cm. longis brunneo-pubescentibus. Inflorescentia axillaris solitaria brevipedunculata. Flores ignoti. Fructus ovoideus, usque ad 2 cm. longus, 1.5 cm. in diam., calyce crasso hypocrateriforme 12 mm. lato, pedicello incrassato usque ad 1 cm. longo, lobis persistentibus incrassatis carnosis marcidis.

DISTRIBUTION: Hainan.

CHINA. Hainan: Loktung, *S. K. Lau 26781,* May 17, 1936, shrub 3 m. high, diam. 3 cm. (AA).

The first time this genus has been reported from Hainan. The species is similar to *Neocinnamomum Lecomtei* Liou from Tonkin. It is easily distinguished, however, by the pubescence on the leaves and branches.

Neocinnamomum Wilsonii, spec. nov.

Litsea fruticosa Gamble in Sargent, Pl. Wilson. **2**: 77. 1914, p.p.

Arbor parva vel frutex 2–7 m. altus, ramulis glabris teretibus striatis brunneis maculosis. Folia alterna, membranacea, late ovata rhomboideave, 4–6 cm. longa, 3–4 cm. lata, acuminata a basi varie cuneata, supra conspicue reticulata, glabra, margine supra medium, leviter undulato, trinervia, petiolo gracili, 0.5–0.7 cm. longo, glabro. Inflorescentia axillaris solitaria, subsessilis, subumbellata, pauciflora. Flores 1–3, circa 2 mm. longi, pedicello gracili usque ad 4 mm. longo, lobis 6, 3 interioribus extus pubescentibus, antherae loculis 4, in uno plano, 2 lateralibus, 2 extrorsis introrsisve. Fructus globosus usque ad 11 mm. in diam., calyce crasso hypocrateriformi, 5 mm. lato, pedicello leviter incrassato usque ad 1 cm. longo, lobis persistentibus marcidis.

DISTRIBUTION: western and central China.

CHINA. Szechuan: *W. P. Fang 5664;* Taning Hsien, alt. 2-3000 ft., *E. H. Wilson 4587,* 1910, bush 12 ft., (holotype, AA). Hupeh: *H. C. Chow 509.*

There is no species of *Cinnamomum* with which this species may be confused. It is unique also in *Neocinnamomum.* However, it has been determined and treated variously as *Lindera*[1], *Litsea,* and finally by Liou as *Cinnamomum Fargesii.*

HERBARIUM, ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

[1]Allen, Ann. Missouri Bot. Gard. **25**: 399. 1938.

NEW AND NOTEWORTHY SPECIES OF ASIATIC JASMINUM

CLARENCE E. KOBUSKI

Jasminum (§Unifoliolata) **albicalyx,** spec. nov.

Frutex scandens ramulis pubescentibus. Folia opposita vel subopposita, simplicia, membranacea, sparse pubescentia, saepe in axillis nervorum barbata, ovata, 6–9 cm. longa, 3–4.2 cm. lata, basi subrotundata vel cuneata, apice acuta, subtus albida, costis venisque elevatis, petiolis 2–4 mm. longis. Inflorescentia cymosa, triflora, subsessilis, duobus paribus bractearum anguste linearium 6–8 mm. longarum suffulta. Calyx albidus, puberulus, tubo 2 mm. longo, lobis 5–6 subulato-setaceis 6–9 cm. longis. Corolla alba, tubo 14 mm. longo, lobis 5, ca. 5 mm. longis ovatis acuminatis. Fructus ignotus.

KWANGSI: Yung Hsien, Ch'ang An, over rocks in forest, alt. 200 m., *A. N. Steward & H. C. Cheo 1172,* (TYPE AA) Oct. 23, 1933 (vine with white flowers).

This unusual species is characterized by its three-flowered cyme in which the calyces are white or yellowish white. The flowers are subsessile or nearly so, subtended by two pairs of bracts with the upper pair of bracts occasionally longer than the lower pair. The leaves are dull green in some cases and gray-green in others. The midrib and veins are elevated on the lower surface, and white or yellowish white. Scattered pubescence is found on the lower surface, often in clusters in the axils of the lower veins. The branchlets and often the leaves are not always truly opposite, as is usually the case in the section Unifoliolata.

Jasminum (§Unifoliolata) **cinnamomifolium,** spec. nov.

Frutex scandens, 1–2 m. altus, glaber, ramulis gracilibus teretibus. Folia opposita, simplicia, coriacea, oblong-lanceolata, 7–10 cm. longa, 2–3 cm. lata, basi late cuneata, raro subrotundata, apice acuminata, supra viridia, subtus paullo pallidiora, trinervia, nervis duobus lateralibus e basi ad medium rectis, supra undulatis; petioli 7–10 mm. longi. Inflorescentia triflora in apice ramulorum, 1 vel 2 paria foliorum et basin versus 1 vel 2 paria bractearum minutarum gerentium; calyx glaber, tubo gracili, ca. 3 mm. longo, lobis 5, subulato-setaceis ca. 2 mm.

longis; corolla alba, tubo ca. 1 cm. longo, lobis 9 lineari-lanceolatis ca. 3 cm. longis, 1.5–2 mm. latis. Fructus in sicco flavescens (viridis ex collectore) carpidio solitario late ovoideo 10–11 mm. longo et 9–10 mm. lato.

HAINAN: Kumyun, on slope in dense woods, *S. K. Lau 27620* (TYPE AA), Aug. 6, 1936 (scandent, twining, 1 m. high; leaves green above; fruit green). — Loktung, in dense woods, *S. K. Lau 27106*, June 12, 1936 (climbing, 2 m.; leaves green above; flowers yellowish white).

Jasminum cinnamomifolium is characterized by three-nerved, coriaceous, oblong-lanceolate leaves, flowers in threes and solitary fruits. In the leaves, the two main lateral veins begin at the base and curve evenly along the margin for the basal half of the leaf. In the upper half, these same veins become somewhat undulate upon being joined by less conspicuous cross-veins. The flowers, in clusters of threes, terminate axillary branchlets. On these branchlets occur either a single or two pairs of leaves plus one or two pairs of minute bracts. In *Lau 27105* (flowering specimen), these leaves are like the main stem leaves in size and shape (7–10 cm. long, 2–3 cm. wide). However, in *Lau 27620* (fruiting specimen), these branchlet leaves, although similar in shape are considerably smaller (2.7–3.5 cm. long, 0.85–1.0 cm. wide).

This species is closely related to *J. urophyllum* Hemsley but can be easily separated by the subulate-setaceous calyx-lobes. In *J. urophyllum* the calyx-lobes are very short and acute.

Another closely allied species is *J. laurifolium* Roxb. This species can be separated from *J. cinnamomifolium* by its narrower, heavy coriaceous leaf with revolute margin. Because of the heavier texture of the leaf, the two main lateral veins are obscured while the midrib is most outstanding. The flowers, in both species, are in threes. In *J. laurifolium* the three pedicels of the flowers are joined to a common peduncle. In the present species, there is no peduncle.

The following specimen, *C. W. Wang 72764*, collected in Yunnan at Chen-Kang Hsien, in March 1936 at an altitude of 1400 m. undoubtedly belongs to this species. It is a rather wretched specimen consisting of two detached leaves and a single unopened flower. However, these same leaves, such as they are, and the single flower, along with the terminal floral arrangement of the specimen are enough to show that it belongs with this species. This specimen was not used in compiling the original description because of its fragmentary nature and its origin (Yunnan). Before citing Yunnan as a record of spontaneous growth, better specimens should be collected.

Jasminum cinnamomifolium Kobuski var. **axillare**, var. nov.

A typo differt floribus axillaribus, calycis lobis longioribus (4–16 mm.).

YUNNAN: Chen-Kang Hsien, ravine, alt. 2000 m., *C. W. Wang 72170*, March 1936 (vine with greenish yellow flowers). — Chen-Kang Hsien, ravine, alt. 1600 m., *C. W. Wang 72261* (TYPE AA), March 1936 (flowers white). — Keng-Ma, woods, alt. 1600 m., *C. W. Wang 72830*, Apr. 1936 (vine with greenish white flowers). — Fo-Hai, mixed forest, alt. 1550 m., *C. W. Wang 73847*, May 1936 (vine with greenish yellow fruit). — Keng-Ma, ravine, alt. 1670 m., *C. W. Wang 72892*, Apr. 1936 (vine with white flowers). — Nan-Chiao, forest on mountain slope, alt. 1350 m., *C. W. Wang 75013*, June 1936 (vine with green fruit). — Lan-Tsang Hsien, ravine, alt. 1600 m., *C. W. Wang 76498*, May 1936 (vine with green fruit).

The chief differences of this variety from the species are the axillary flowers and the elongated calyx-lobes. The lobes of the species measure approximately 2 mm. long. In the variety calyx-lobes varied from 4–6 mm. found in *Wang 75013, 72830* and *72170* to 12–16 mm. found in *Wang 72261* and *73847*. In the species the flowers are found in threes and always terminating axillary flower branchlets. In the variety, the flowers are usually solitary and confined to the leaf axils.

Jasminum laurifolium Roxburgh, Hort. Bengal. 3. 1814, nom.; Fl. Ind. **1**: 91. 1821. — DeCandolle, Prodr. **8**: 303. 1844. — Kurz, For. Fl. Brit. Burma, **2**: 152. 1877. — C. B. Clarke in Hooker f., Fl. Brit. Ind. **3**: 597. 1882. — Kobuski in Sunyatsenia, **3**: 110. 1936.

Jasminum angustifolium Ker in Bot. Reg. **7**: t. 521. 1821, non Willd.

Jasminum angustifolium Ker var. *β laurifolium* Ker in Bot. Reg. **7**: t. 521. 1821.

KWANGSI. Shap Man Taai Shan: near Iu Shan village, s.e. of Shangsze, Kwangtung border, fairly common in dry, silt or sandy soil, *W. T. Tsang 22194*, May 3, 1933 (scattered shrubs, 1 m. with fragrant white flowers). — near Hoh Lung village, s.e. of Shang-sze, Kwangtung border, in dry steep slope of silt and solid rock, *W. T. Tsang 22498*, June 18, 1933 (fairly common shrub 1 m. high with blue-black fruit). — Tang Lung village, s.e. of Shang-ze, Kwangtung border, in thicket, *W. T. Tsang 24259*, September 14, 1934 (fairly common climber 1.5 m. high; fruit bluish black). — Hainan: Mo San Leng, in forest, alt. 900 m., *N. K. Chun & C. L. Tso 44306*, Nov. 1932 (bushy shrub 1–1.5 m. high).

In 1936, *Jasminum laurifolium* Roxburgh* was reported from China, probably for the first time. Since then three more collections have come to the attention of the author, two from Kwangsi and one from Hainan. Formerly this handsome shrub was known only from India.

Kurz in For. Fl. Brit. Burma says that the fruit is above 1/3 inch long. This is the only reference to fruit size that I have been able to find in literature. The Hainan specimen collected by Chun & Tso possesses a single fruit, broadly oblong measuring 18 mm. × 11 mm. This is much larger than fruit cited by Kurz, in fact, the largest fruit I have ever seen in the genus *Jasminum*. Since only a single specimen is available, I have hesitated to examine it other than externally and to make measurements hoping for future specimens to make sectional examination. Also it appears from this meagre specimen that the inflorescence is one-flowered rather than three-flowered as is the typical case.

Kurz in speaking of the leaves says, "leaves linear to linear-lanceolate, rounded or acute at the base, on a 2 lin. long petiole jointed at the middle, 2–5 in. long, bristly acuminate, entire, glabrous, thinly coriaceous, the lateral nerves thin and uniting from the base into a more or less distinct intramarginal nerve and without any net-veination between them." *Tsang 24259* possesses larger leaves (up to 10 cm. long, 3.1 cm. wide) than the other cited specimens (up to 6.0 cm. long, 1.8 cm. wide). Also *Tsang 24259* instead of being 3-nerved is several-nerved. The two basal lateral nerves run parallel to the margin. Besides these, are usually 2 more pairs of veins also parallel beginning further up the midrib. These veins do not join with the outer veins as cross-veins. In the other cited specimens are found obscure cross-veins which occasionally join with the marginal parallel veins making the latter somewhat undulate. In some leaves the veining is similar to *Tsang 24259* and in other cases as obscure as those mentioned by Kurz.

Jasminum (§Unifoliolata) **pericallianthum,** spec. nov.

Frutex scandens glaber. Folia opposita, simplicia, coriacea, oblongo-ovata, 11–17 cm. longa, 4–6.5 cm. lata, basi cuneata vel subrotundata, apice acuminata, costis venisque subtus elevatis, petiolis 8.0–8.5 mm. longis. Inflorescentia axillaris, laxe cymosa, 6–12-flora; calyx glaber, tubo 2.5–3 mm. longo in pedunculum incrassatum 8–8.5 mm. longum attenuato, lobis 5 brevibus acutis ca. 0.5 mm. longis. Corolla nivea (5 cm. diametro ex collectore), tubo gracili 3.5–4 cm. longo, apice ampliore, lobis 5 ovatis ca. 2 cm. longis 1.0–1.4 cm. latis. Fructus ignotus.

*Kobuski in Sunyatsenia, 3: 110. 1936.

BURMA: hills east of Fort Hertz, alt. 1200 m., *F. Kingdon Ward 9078*, Dec. 30, 1930 (magnificent twining climber in the jungle; flowers snow white, fragrant, 2 inches across, tube 1 3/4 inches).

"A magnificent twining climber in the jungle." In his field-notes, F. Kingdon Ward makes this memorandum. On looking at the specimen, one can readily see why he so describes it. With flowers, equalled by no *Jasminum* ever studied by the author, this species is probably one of the most beautiful in the genus. Loose cymes of snow-white fragrant flowers which easily measure two inches across the corolla-lobes, and corolla tubes nearly two inches in length are outstanding characters of the species. Also the stocky thickened pedicels which enlarge starting from the base until nearly of the same size as the calyx-tube with scarcely any constriction at this point offer another interesting specific distinction.

Jasminum (§Unifoliolata) **pilosicalyx**, spec. nov.

Frutex scandens ramulis dense pilosis. Folia opposita, simplicia, papyracea, ovato-elliptica, 8.5–11 cm. longa, 5–7.5 cm. lata, basi subcordata vel subrotundata, apice obtusa subito acuminata, margine ciliata, costa venisque subtus pilosis, petiolis 7–9 mm. longis. Inflorescentia axillaris, cymosa triflora. Flores immaturi. Calyx dense pilosus, tubo 1–1.5 mm. longo, lobis 5 subulato-setaceis 5-6 mm. longis. Fructus ignotus.

HAINAN: Po-ting, in forest, alt. 400 m., *F. C. How 73094*, July 5. 1935 (bark gray; leaves green above, pale green beneath; calyx with white pubescence).

A pubescent calyx in the genus *Jasminum* is no novelty. However, the white pilose pubescence of *J. pilosicalyx* is the most distinctive calyx pubescence seen in any species of the genus. This white pilosity may exist only in the early flowering stage since the stems and leaves are also pilose but of a more nearly tan color. Since only a single immature flower can be found on How's specimen, it is difficult to obtain any true concept of the corolla's ultimate proportion. The papyraceous, ciliate leaves are other distinctive features of the species.

Jasminum (§Unifoliolata) **Rehderianum** Kobuski in Sunyatsenia, 3: 110. 1936.

This outstanding species is confined so far as known at present to Hainan. It has been collected four times from this region, twice by *H. Y. Liang* (*62844*, *62986*) in September 1933, once by *C. Wang* (*33768*) in August 1933 and finally by *C. I. Lei* (*1456*) in August 1934.

Lei remarks that it is found abundantly in the Lam ko district and vicinity on dry gentle slopes, in sand and on rocky seashore.

Jasminum (§Unifoliolata) **robustifolium**, spec. nov.

Frutex scandens robustus glaber. Folia opposita, simplicia, coriacea, oblongo-ovata, basi cuneata vel subrotundata, apice acuminata, 10–22 cm. longa, 5–9.3 cm. lata, venis lateralibus ad costam perpendicularibus, petiolis robustis 2–2.5 cm. longis, ad 2 mm. latis. Inflorescentia paniculata, axillaris. Flores ignoti. Fructus cinnabarinus (ex collectore) unicus visus carpidio uno tantum ovato 13–15 mm. longo 7–10 mm. lato.

YUNNAN: Tsang-Yuan, ravine, alt. 1200 m., *C. W. Wang 73304*, Apr. 1936 (vine with orange-red fruit) (AA).

Closely allied to *J. Wangii*, but separated easily by its paniculate inflorescence and leaves with nearly perpendicular rather than acutely angled veining. This species is very outstanding in the genus because of its very large leaves and generally robust stature. In China, its nearest ally in size is *J. coffeianum* Hand.-Mazz. However, again its paniculate inflorescence separates the two. Also, the leaves in *J. coffeianum* are more coriaceous.

Jasminum (§Unifoliolata) **Wangii**, spec. nov.

Frutex scandens glaber, ramulis minutissime glandulosis. Folia opposita, simplicia, coriacea, oblongo-ovata, 15–26 cm. longa, 6.8–10.3 cm. lata, decidua, basi cuneata vel subrotundata, apice subito acuminata, venis subangulo acuto divergentibus, petiolis ca. 2 cm. longis. Inflorescentia racemosa, terminalis axillarisque, pedicellis pedunculisque glandulis minutissimis dense dispositis. Calyx glaber, pedicello 1.5–2.5 cm. longo, tubo ca. 3 mm. longo, lobis 5 acutis parvis ca. 5 mm. longis; corolla alba, tubo gracili 2–2.5 cm. longo, lobis 6–7 lineari-lanceolatis vel ovatis, 10–11 mm. longis, plerumque 2–2.5 mm. latis. Fructus ignotus.

YUNNAN: Sheou-bang-chou-chian, Che-li Hsien, woods in mountainous ravine, alt. 900 m., *C. W. Wang 79673* (TYPE AA), Sept. 1936 (leaves light green underneath; flowers white). — Kuen-ger, Che-li Hsien, in mixed forest, alt. 1000 m., *C. W. Wang 79217*, Oct. 1936 (vine 2 m. long; flowers white). — Jah-leei, Che-li Hsien, in mixed forest, alt. 1400 m., *C. W. Wang 79151*, Oct. 1936 (climber in forest with white flowers).

Jasminum Wangii closely resembles *J. robustifolium* from which it is easily separated by the racemose inflorescence, veins at an acute angle and by the dense covering of minute glands on the young branches

and pedicels of the inflorescence which can be seen only under a high-powered binocular. On the very young growth, especially in the inflorescence, these glands are colored orange-brown, fading either by drying or by maturity to brown. On the most mature portions of the specimen these glands fade out entirely. Compared with the usual subulate-setaceous or foliaceous calyx-lobes, generally found in the genus, the lobes of this species seem quite reduced. The corolla lobes of *Wang 79151* differ from the other two specimens cited in being ovate (5 mm. wide) rather than linear-lanceolate (2–2.5 mm. wide). In this specimen, however, there are only two flowers and of these only one had opened.

Jasminum (§Trifoliolata) **anisophyllum**, spec. nov.

Frutex (probabiliter scandens) 3 m. altus, fere undique dense pilosus, ramulis floriferis teretibus. Folia opposita, membranacea, trifoliata, foliolis valde inaequalibus, terminali oblongo-ovato, basi subcordato vel rotundato, apice acuminato, 8.5–10.5 cm. longo, 4–4.8 cm. lato, venis primariis lateralibus 4–5, costa supra impressa subtus elevata, petiolulo 2.5–3 mm. longo, lateralibus multo minoribus ovatis, ca. 1.4 cm. longis, 7 mm. latis, sessilibus vel subsessilibus; petiolis 2–3 mm. longis. Inflorescentia axillaris cymosa. Calyx dense pilosus, tubo 3–4 mm. longo, lobis 5 subulato-setaceis ca. 2 mm. longis. Corolla alba, tubo gracili ca. 2 cm. longo, lobis (5 ?) linearibus, 5–8 mm. longis, ca. 2 mm. latis. Fructus ignotus.

YUNNAN: You-louh shan, Che-li Hsien, mixed forest, alt. 1150 m., *C. W. Wang 78119*, Sept. 1936 (height 3 m.; flowers white).

Jasminum anisophyllum, *J. sinense* and *J. Forrestianum* are closely joined in a small distinctive group. The main distinction of this group is based on the lateral leaflets being markedly smaller than the terminal leaflet. In *J. anisophyllum* these lateral leaflets are minute in comparison with those of the other two mentioned species. In fact, the contrast between the terminal and lateral leaflets is so great that the laterals at first glance are generally mistaken for bracts. Also the lateral leaflets are sessile or subsessile in *J. anisophyllum* and the petiolule of the terminal leaflet measures only 2–3 mm. Both these measurements are far lower than those of the other two species. The corolla-tube in *J. anisophyllum* measures approximately only 2 cm. long. Corolla-tubes of *J. sinense* can be found measuring up to 4 cm. The pilose pubescence is another outstanding feature of *J. anisophyllum*. This pubescence exists over the whole plant and is most pronounced on the midrib and veins of the leaves and on the calyx.

Jasminum (§Trifoliolata) **Forrestianum,** spec. nov.

Frutex scandens glaber, 2.5–6 m. altus ramulis floriferis angularibus vel sulcatis. Folia opposita, trifoliata vel simplicia, coriacea vel subcoriacea, foliolis inaequalibus, terminali oblongo-ovato, basi truncato vel subcordato, apice acuminato, 6–13 cm. longo, 3.3–6.2 cm. lato, costa supra impressa, subtus elevata, petiolulo 1.2–2 cm. longo, lateralibus minoribus ovatis, basi obliquis, apice acuminatis, ca. 3.5–6 cm. longis, 1.9–3 cm. latis, petiolulis 1.5–2 mm. longis, petiolis 1.3–2 cm. longis. Inflorescentia cymosa vel subpaniculata, axillaris. Pedicelli 5–6 mm. longi. Calyx glaber, tubo 1.5–2 mm. longo, lobis 5 minutissimis triangularibus vix 0.5 mm. longis. Corolla extus rosea vel pallide purpurea, intus cereo-alba, tubo 1.2–1.5 cm. longa, lobis 5 ovatis 7–9 mm. longis ca. 6 mm. latis. Fructus (atrovirens, ex collectore) in sicco flavescens, carpellis duobus vel solitariis, late globosis, ovoideis vel subrotundatis, ca. 10 mm. longis.

YUNNAN: Flanks of the Mingkwong Valley, on trees and shrubs, lat. 25° 15′ N., alt. 2135 m., *G. Forrest 7861* (TYPE AA), May 1912 (scandent shrub 2.5–6 m.; flowers interior waxy white, exterior flushed crimson-rose, deliciously fragrant). — Precise locality and date lacking, *G. Forrest 9811.* — Chen-Kang Hsien, alt. 2800 m., *C. W. Wang 72464,* March 1936 (climbing; flowers light purple). — Chen-Kang Hsien, alt. 2600 m., *C. W. Wang 72462,* March 1936 (fruit green). — Lung-ling Hsien, along stream, alt. 2200 m., *H. T. Tsai 55006,* Jan. 7, 1934 (climbing shrub with green to black fruit). — Lung-ling Hsien, in forest, alt. 1800 m., *H. T. Tsai 55745,* Apr. 11, 1934 (climbing shrub with dark purple fruit). — Shang-pa Hsien, in ravine, alt. 2000 m., *H. T. Tsai 54520* (twining shrub). — Locality and date lacking, *H. T. Tsai 57012.*

Jasminum sinense is the closest relative of this species and may be easily separated by its long graceful corolla-tubes (up to 4 cm.), slender corolla-lobes and subulate-setaceous calyx-lobes. In *J. Forrestianum* the corolla-tubes are less graceful and measure only up to 1.3 cm.; the corolla-lobes are much broader and the calyx-lobes are small. Also the stamens are clearly exserted while in *J. sinense,* the stamens are inserted.

From *J. anisophyllum,* another close relative, it can be separated by its glabrous, long-petioled leaves, longer petiolulate lateral leaflets, small calyx-lobes and furrowed flowering branches.

This species naturally falls in the section Trifoliolata because of its usually trifoliolate leaves. Occasionally, specimens are found which

are unifoliolate (*Forrest 9811, Tsai 54520, 55745*). However, *Tsai 54520,* for example, even though mostly simply leaved, has occasional trifoliolate leaves. Since the specimens cited above agree in all other features, it seems undesirable to separate them on this variable character.

The veins are distinctly impressed on the upper surface and elevated on the lower surface. Also the lateral veins sweep upward near the margin and join with the veins immediately above, thus making an undulating marginal vein.

Jasminum Forrestianum is named after that indefatigable botanical collector, the late George Forrest, to whom we owe so much of our knowledge of the extremely rich flora of western China and the adjoining regions.

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BOTANICAL RESULTS OF THE ARCHBOLD EXPEDITIONS NEW GUINEA RECORDS OF ANNONACEAE AND MENISPERMACEAE

L. Diels

MENISPERMACEAE

Tinospora polygonoides Diels, Pflanzenreich **46(IV.94)**: 136. 1910.

Petala nonnunquam aliquanto maiora, ad 4 mm. longa, 2.5 mm. lata.

Mabaduan, Western Division, *L. J. Brass 6501, 6477.* — Tarara, *L. J. Brass 8541.*

Known only from New Guinea.

Hypserpa laurina (F. Muell.) Diels, Pflanzenreich **46(IV.94)**: 209. 1910.

Sepala intima maiora, 5-nervosa.

Lower Fly River, east bank, opposite Sturt Island, rain forest, large liana of ridges, climbing by tendrillate branches with or without leaves, flowers green, fruits red, Oct. 1936, *L. J. Brass 7995.* — Tarara, Wasi Kussa River, Western Division, *L. J. Brass 8736.*

The first record of this species outside N. E. Australia.

Sarcopetalum Harveyanum F. Muell. Pl. Vict. **1**: 27, 221, suppl. pl. 3. 1860–1862; Diels, Pflanzenreich **46(IV.94)**: 252. 1910.

Endocarpium 4–6 mm. longum, 5–7 mm. latum ideoque plerumque quam illud formae typicae (3–3.5 mm. longum, 4–4.5 mm. latum) conspicue amplius, tuberculis maioribus fere aculeolatum.

Lake Daviumbu, Middle Fly River, rain forest, common twiner ascending substage trees, infl. lateral, on lower stem, fr. soft, red, 6–8 mm. diam., Sept. 1936, *L. J. Brass 7714.* — Tarara, Wassi Kussa River, Western Division, small climber common in rain forests, Jan. 1937, *L. J. Brass 8659.*

The first record of this monotypic genus outside N. E. Australia. The New Guinean specimens agree completely with those of Australia; only the endocarp is somewhat larger.

ANNONACEAE

Uvaria micrantha (A. DC.) Hook. f. et Thoms. Fl. Ind. **1**: 103. 1855; Hook. f., Fl. Brit. Ind. **1**: 51. 1872.

Guatteria micrantha A. DC. Mém. Fam. Anon. 42. 1832.

Tarara, Wassi Kussa River, Western Division, rain forest, liane, fls. purple-brown, Jan. 1937, *L. J. Brass 8557.* — Kanosia, forest on edge of mangrove swamps, sea level, ca. 8 feet tall, calyx brownish-olive,

corolla brown, Feb. 2, 1935, *C. E. Carr 11088*. — Lolorua, forest, ca. 100 feet, climber, fruit orange, Feb. 24, 1935, *C. E. Carr 11509*.

The species is distributed from Further India and Sumatra to the Philippines. First records for New Guinea.

Rauwenhoffia Leichhardtii (F. Muell.) Diels, comb. nov.

Unona Leichhardtii F. Muell. Fragm. **3**: 41. 1842.
Melodorum Leichhardtii Benth. Fl. Austr. **1**: 52. 1863; Bailey, Queensl. Flora **1**: 25. 1899.
Rauwenhoffia uvarioides Scheffer, Ann. Jard. Buitenz. **2**: 23. 1885; Diels, Bot. Jahrb. **44**: 125. 1912.
Uvaria lutescens K. Schum. in K. Schum. & Hollr., Fl. Kaiser-Wilhelmsl. 48. 1889; K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Süds. 315. 1901.

Lake Daviumbu, Middle Fly River, large climber, common in rain forest canopy, Aug. 1936, *L. J. Brass 7584;* same locality, flowers yellow-brown, sweet-scented, Sept. 1936, *L. J. Brass 7681*. — Lower Fly River, east bank opposite Sturt Island, rain forest, common high climbing liane on ridges, fruit orange-brown, Oct. 1936, *L. J. Brass 7993*.

Mitrephora Versteegii Diels, Bot. Jahrb. **44**: 153. 1912.

Southeast New Guinea: Palmer River, two miles below junction Black River, common in rain forest substage 100 m. alt. slender tree attaining 8–9 m., numerous golden-yellow flowers in lateral fascicles on old wood, July 1936, *L. J. Brass 7311*.

Orophea rhytidocarpa Diels, n. sp.

Arbor ex coll. parva circ. 3 m alta. Rami juniores pilosi. Foliorum petiolus crassus brevis 0.3–0.4 cm. longus, pilosus, lamina papyracea, glabra, lineari-lanceolata, apicem versus sensim longe angustata, apice ipsa obtusiuscula, basi subobliqua, 30–35 cm. longa, 6–6.5 cm. lata, nervi laterales primarii 12–15 a costa abeuntes, supra inconspicui, subtus prominuli. Pedunculi axillares, longissimi, penduli. Carpidia pauca (2 ?), breviter (circ. 3 mm.) stipitata, divaricata, subglobosa, dense velutinella, viridia, costulis irregulariter reticulatis conspicue rugosa, viva ex coll. 2.5 cm., sicca circ. 2 cm. diam.

Fly River: 528 mile Camp, forest undergrowth, on ridges, alt. 80 m., small sparsely branched near-tree 3 m. high, leaves secund, a solitary 2-lobed rugose green fruit on a long axillary peduncle (lobes of fruit 2.5 cm. diam.) May 1936, *L. J. Brass 6736*.

Near *O. dolichonema* Diels from N. E. New Guinea, but differs in the narrower leaves, the more distant nerves, hardly connected at the margin, and the ripe, strongly corrugated carpels.

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BOTANICAL RESULTS OF THE ARCHBOLD EXPEDITIONS NEW AND NOTEWORTHY PAPUAN SCROPHULARIACEAE. II.

Francis W. Pennell

Through the kindness of Dr. E. D. Merrill of Harvard University there has been submitted for my study a further series of specimens collected in Papua by Mr. L. J. Brass, under a second expedition conducted to that little-known country by Mr. Richard Archbold in association with the American Museum of Natural History. Most of these were gathered between September and November, 1936 along the lower and middle course of the Fly River. This, the largest stream in New Guinea, lies in western Papua and so about the middle of the southern side of the island. This portion of New Guinea is situated just opposite Cape York, which terminates the northeastern extension of Queensland, and thus is geographically not far away from the Australian continent. For a map of this region see Jour. Arnold Arb. 19: 174. 1938.

The plants gathered are all from low altitudes. In my previous paper[1] I stressed the sharp contrast between the lowland and highland Scrophulariaceae in New Guinea, a difference which had been noticed earlier by Dr. Schlechter. Among the earlier Archbold collections only a specimen of *Buchnera* had appeared out of its expected elevation, but Mr. Brass has since assured me that there had been an error in transcribing his record of altitude, for the specimen actually came from 1500, and not 2840 meters above the sea.[2] The plants of the second collection are all characteristic members of the lowland scrophulariaceous flora.

Some of these plants are widespread Indo-Malayan species, adding more representatives of the class that was so dominant in the former series of Archbold Papuan plants. Among those now first reported the most striking is *Artanema longifolium*, of which I have seen no previous record from east of Wallace's Line. But others are species long known from tropical northeastern Australia, where there exists a small group of supposedly endemic members of the family. Probably all of these

[1]Brittonia 2: 177-188. 1936.
[2]Correction made in Brittonia 3: 95. 1938.

will prove to be present also in southern New Guinea, since otherwise Australia is nearly lacking in Scrophulariaceae. To the extensive number of Indo-Malayan plants of this family, which have clearly extended eastward as discussed in my preceding paper, should be added this smaller group of Austro-Malayan plants, a group that must prove to be ultimately, though more remotely, also of Indo-Malayan origin.

As so little is known of the flora of the Fly River valley it seems worthwhile to record all the species of this small collection of Scrophulariaceae. As in the previous list, they are inserted under the generic and specific numbers of Schlechter's "Die Scrophulariaceen Papuasiens,"[3] and the species and genera now first reported from New Guinea are noted by an asterisk. The addition of these makes a new total for the island of 28 lowland and 13 alpine species of Scrophulariaceae, but I confidently expect to see this proportion reversed when more of the difficult mountain areas have been botanically explored.

1. **Limnophila** R. Br.

3. **L. aromatica** (Lam.) Merr. Interpret. Rumph. Herb. Amb. 466. 1917.

Lake Daviumbu, Middle Fly River, plentiful in grassy shallows of swamps and lagoons, *Brass* 7532; flowers puce-colored.

2. **Adenosma** R. Brown

To the two species enumerated by Schlechter is to be added the following, remarkable for its ternate instead of opposite phyllotaxy. It seems to be akin to both *A. coeruleum* R. Br.[4] and *A. papuanum* Schlechter, resembling them in habit, but differing in ternate phyllotaxy, lack of glandularity, inflorescence more spike-like, its upper sepal less conspicuously enlarged, its upper corolla-lobes distinct at apex, and its seeds narrower. It further differs from current descriptions of *Adenosma* in the hairiness of the landing-stage of the lower lip, but this is likely to prove an overlooked generic character.[5] Of course such hairs are part of the floral mechanism, helping the bee to alight on the expanded lower lip and so to enter the flower in erect posture.

[3]Bot. Jahrb. **59**: 99-117. 1924.

[4]R. Brown, Prodr. 1: 442. 1810. Figured in Banks and Solander, Illustr. Bot. Cook's Voy. 2: *t. 218*. 1901, and described in the accompanying text (p. 66).

[5]Although its localization was not realized, this hairiness was evidently meant by the phrase "tubus . . . interne pilosiusculus" in the description accompanying Banks and Solander's plate.

*3. **A. ternatum** Pennell, sp. nov.

Herba perennis (?), 5–10 dm. alta, ramosa; caulis et rami teretiusculi, hirsuti, eglandulosi; folia ternata, petiolata, triangulari-ovata, obtusa, basi cuneata, margine crenato-dentata, utrinque hirsuto-pubescentia, lamina 2–2.5 cm. longa, infra medium 1.5–2.3 cm. lata, petiolo 4–9 mm. longo; flores inferiores plus minusve remoti, alii in racemum spiciformem congesti; bracteolae duae, lineares, calyce breviores; sepala inaequalia, lanceolata vel lineari-lanceolata, 4–6 mm. longa; corolla 10 mm. longa, tubulosa, bilabiata, violaceo-caerulea, extus glabra, labio supero apice bifido, labio infero villoso, trilobato, lobis retusis; stamina 4, glabra, inclusa, filamentis inferis longioribus, connectivis globosis, et antherarum superarum cellulis aequalibus, sed inferarum uno rudimento inaequalibus; capsula 7–8 mm. longa, nigra, latere ad septum sulcata, loculicida et tardius etiam septicida; semina 0.4 mm. longa, cylindrica, rugoso-reticulata.

Herb apparently perennial,[6] 5–10 dm. tall or more, short-branched above, hirsute throughout but not glandular. Stem and branches teretish, laxly or densely foliate. Leaves ternate, petiolate, triangular-ovate (wider than in *A. coeruleum*), obtuse, at base cuneate, margin crenate-dentate, hirsute-pubescent on both surfaces or beneath, mainly so on the prominent veins, blades 2–2.5 cm. long, below the middle 1.5–2.3 cm. wide, petiole 4–9 mm. long. Lower flowers somewhat isolated, the upper forming a short spike-like raceme; lower bracts leaf-like, upper oblanceolate, about equaling the sepals. Pedicels 1–2 mm. long. Bractlets 2, linear, shorter than the calyx. Sepals unequal, lanceolate or linear-lanceolate, 4–6 mm. long. Corolla 10 mm. long, tubular-bilabiate, violet-blue (without record of pattern), externally glabrous; upper lip projecting-arched, its lobes rounded, distinct at apex;[7] lower lip 2-ridged and villose, distally with three retuse lobes. Filaments four, included, glabrous, the anterior pair slightly longer; connective knob-like; postero-laterals with two nearly equal anther-cells, antero-laterals with only one anther-cell, the other a mere rudiment. Stigmas wide, plate-like, or perhaps arc-like at the apex of such fused plates, which make the distal portion of the fused styles broadly winged. Capsule 7–8 mm. long, black, firm, laterally furrowed on septum (as in *Sophronanthe*), distally attenuate, loculicidal and secondarily somewhat septicidal. Seeds 0.4 mm. long, cylindric, brown, rugose-reticulate.

[6]As suggested by the broken base of No. 7816. If so, this forms a strong contrast with *Adenosma coeruleum* and *A. papuanum*.

[7]Upper lip drawn as with entire apex on Banks and Solander's plate, and so described in the accompanying text of *Adenosma coeruleum*.

Type, savannas, Lake Daviumbu, Middle Fly River, Papua, collected in flower and fruit in September, 1936, by *L. J. Brass,* no. 7816, and deposited in Herb. Academy of Natural Sciences of Philadelphia. The plant was reported as "abundant on ground grazed short and trampled by wallaby". More leafy specimens, not yet in blossom, were found occurring as common weeds in old deserted gardens at Mabaduan, Western Division, Papua, where gathered in April, 1936, by *Brass,* no. 6574.

3. **Torenia** Linnaeus

1. **T. polygonoides** (Benth.) Benth., Scroph. Ind. 39. 1835.

Lake Daviumbu, Middle Fly River, on leafy ground near edge of swamp in rain-forest, *Brass* 7551; flowers pink. A wide-spread Indo- and Austro-Malayan species.

*3a. **Artanema** D. Don

The large growth, with accompanying large purple flowers and elongated leaves, distinguishes this genus at once from other Oriental and Australian Gratioleae. The enlarged knob-like outgrowths of the lower pair of filaments are also distinctive. As in *Lindernia,* these knobs are clearly caused by a folding of the filaments, the conducting tissue passing through them as a loop on its way to the anthers.

*1. **A. longifolium** (L.) Vatke, Linnaea **43**: 307. 1882.

East bank of lower Fly River, opposite Sturt Island, collected in flower October, 1936, by *L. J. Brass,* no. 8143. A wide-spread Indo-Malayan, and evidently also Austro-Malayan, species.

In the collection at hand the leaves reach at least 15 cm. long and 2 cm. wide, while the lower ones were perhaps still larger. The blades are remotely serrate with low teeth, so that both in form and margin they contrast with the plant shown as this species on Tab. 8687 of Botanical Magazine in 1916. However, both Bentham's and Hooker's accounts of it speak of the leaves as varying from entire to serrate, while Linnaeus' description of *Columnea longifolia*[8] gave the leaves as very long and subserrate, a characterization perfectly fitting our specimen.

The species has had a checkered nomenclatural history. It was first considered generically distinct by Vahl, who in 1791[9] constituted it his

[8]Mant. Pl. 90. 1767.
[9]Symb. Bot. **2**: 71. 1791.

genus *Achimenes*, calling this species *A. sesamoides*, but including *Columnea longifolia* in synonymy. Because antedated by *Achimenes* P. Browne of the Gesneriaceae, this genus lapsed. In 1835 David Don based his genus *Artanema* on the Australian *Torenia fimbriata* Hook., and in 1835 Bentham added to it the present species as *A. sesamoides* (Vahl), still including *Columnea longifolia* in synonymy. Although not recorded by the "Index Kewensis," the combination *Artanema longifolium* was actually proposed by Vatke in 1880-82,[10] as indicated by S. A. Skan in 1916,[11] although it has been credited usually either to Wettstein in 1891,[12] or to Merrill in 1923.[13]

Since the leaf-blades of *Artanema longifolium* appear to be so variable in width and degree of cutting, it is likely that A. *angustifolium* Benth.[14] from Singapore will prove to be merely a narrow-leaved extreme. In such forms, as in the present collection from Papua, the basal narrowing of the leaf-blade fails to become petiolar.

4. **Lindernia** Allioni

The second Archbold series includes 5 species of this genus, in which, as previously explained, *Ilysanthes* is also included. One species is proposed as new to science, and for another Dr. Merrill has called attention to a specific name older than that which Dr. Schlechter and I employed.

1. **L. crustacea** (L.) F. V. Muell. Census 97. 1882.

Collections of this wide-spread weed were made at Palmer River (*Brass* 7086) and Lake Daviumbu, Middle Fly River (*Brass* 7537).

*1a. **L. crenata** Pennell, sp. nov.

Herba annua, 2–3 dm. alta, laxe ramosa; caulis et rami ad nodos pilosi; folia ovata, obtusa, basi cuneata, crenata, utrinque pilosa, petiolata, laminis 2–2.5 cm. longis, 0.8–1.2 cm. latis, petiolis hirsutis, 3–5 (infimis 8) mm. longis; pedicelli 15–20 mm. longi, divaricati; bracteolae nullae; sepala 5, lanceolata, attenuata, hirsuta, 7 mm. longa; corolla 7–8 mm. longa, violacea, extus glabra, labio supero concavo lobis rotundatis fere integro, labio infero explanato, trilobato, lobis rotundatis vel retusis; stamina 4, glabra, inclusa, antheris inferis

[10]Linnaea **43**: 307. 1882.
[11]Bot. Mag. **142**: t. 8687. 1916.
[12]Nat. Pflanzenfam. iv. **3b**: 79. 1891 as "A. longiflorum (L.) Wettst."
[13]Enum. Philip. Flow. Pl. **3**: 436. 1923.
[14]DC. Prodr. **10**: 408. 1846.

minoribus rudimentis; capsula 4 mm. longa, brunnea, in calyce inclusa, septicida, septo persistente; semina 0.3 mm. longa, turgida, alveolato-reticulata.

Stems 2–3 dm. tall, ascending or erect, laxly branched, pilose near the nodes, the internodes longer than the leaves. Leaves opposite: blades ovate, 2–2.5 cm. long, 8–12 mm. wide, obtuse, crenate, slightly paler beneath, somewhat pilose on both surfaces, especially on the main veins, the blades abruptly cuneately narrowed to the short hirsute petioles, 3–5, or the lowermost 8 mm. long. Bracts leaf-like, but acute to acuminate and reduced, 1.3–1.7 cm. long. Pedicels 15–20 mm. long, divaricately spreading. Bractlets none. Sepals five, lanceolate, attenuate, hirsute, the upper three slightly longer, 7 mm. long, all more or less united proximally but eventually becoming distinct, or the two lower tending to cohere permanently. Corolla 7–8 mm. long, violet;[15] upper lip broadly arched, with rounded lobes that unite nearly to apex; lower lip slightly spreading, its free lobes shortly rounded or retuse, proximally the base of the lower lip and the throat anteriorly with two slightly puberulent ridges, the corolla elsewhere glabrous. Free postero-lateral filaments incurved, short, arising distad to the middle of the corolla, the proximal portion being so completely fused with the corolla-tube as not to be evident above its surface; their anthers approximate (with cells contiguous in form of St. Andrews' Cross), the connective loosely dilated and extending much below the lower anther-cell.[16] Antero-lateral filaments fused with and partially forming the antero-lateral ridges of the corolla, each distally forming a pyriform-cylindric knob from the base of which arises a short free filament which bears a rudimentary 2-celled anther. Stigmas distinct, lamellate, within the upper lip. Capsule 4 mm. long, ellipsoid, brown, enclosed within calyx, dehiscing septicidally, with the septum persisting as a thin plate. Seeds turgid, irregularly globose, 0.3 mm. long, yellow, with shallowly alveolate reticulations.

Type, common on wet grass plains, Lake Daviumbu, Middle Fly River, Papua, collected in flower and fruit September, 1936 by *L. J. Brass,* no. 7824; in Herb. Academy of Natural Sciences of Philadelphia. Only collection seen.

Probably the kinship of this species is in the Section *Torenioides,* as indicated by the shape and surface-markings of the seeds, the lack of

[15]Recorded as "purple," but the corolla-lobes still show violet, and this or blue-violet is the prevalent color in *Lindernia.* Within the throat anteriorly and proximally yellow coloration is still apparent, and I do not doubt that this species really shows the elaborate color-pattern usual in the genus.

[16]Placed parallel to it, not transversely as in *Gratiola.*

apiculation on the capsule, and the somewhat united sepals. From other members of the group it differs in erect habit and especially in reduction of the anthers of the anterior stamens. In fact, the state of the latter forms an excellent gradation between the old concepts of *Lindernia*, with all the four stamens perfect, and *Ilysanthes*, with the anterior pair of filaments lacking anthers.

2. **L. pusilla** (Thunb.) Merr. Philipp. Jour. Sci. Bot. **11**: 312. 1916.

Lake Daviumbu, Middle Fly River, carpeting small grassless patches on wet savannahs, *Brass* 7882; flowers cream-colored.

5. **L. antipoda** (L.) Alston, Fl. Ceylon **6**: 214. 1931.

Gaima, east bank of Lower Fly River, massed in semi-shade on tidal fore-shores, fresh-water, *Brass* 8318; flowers lavender-colored.

Dr. Merrill has called my attention to the fact that *Gratiola veronicaefolia* Retz. (1810) is a synonym of *Ruellia antipoda* L. (1753), as has been explained by him in his "Interpretation of Rumphius' Herbarium Amboinense" of 1917, where he made the combination *Ilysanthes antipoda* (L.) Merr. (p. 467). Transferred to *Lindernia*, this becomes *L. antipoda* (L.) Alston, Fl. Ceylon **6**: 214. 1931, a name that should replace *L. veronicaefolia* (Retz.) F. V. Muell. in my paper of 1936.

On consulting Alston's volume, I was interested to see that, although without discussion, he had there united under *Lindernia* the different genera which I subsequently brought together in 1935. This course is so logical, that I am not surprised that we have both adopted it independently.

7. **L. ruellioides** (Koenig) Pennell, Brittonia **2**: 182. 1936.

Palmer River, two miles below junction of Black River, sunny positions on rocks swept by river flood-waters, alt. 100 m., *Brass* 7085; flowers lavender-colored.

7. **Centranthera** R. Brown[17]

1. **C. cochinchinensis** (Lour.) Merr. Trans. Amer. Philos. Soc. II. **24**: 353. 1935.

[17]Dr. Merrill accepted *Razumovia* Sprengel (1807) in place of *Centranthera* R. Brown (1810), as the oldest valid generic name for this group, following Britten and Alston; see Bull. Torr. Bot. Club **64**: 589-598. 1937. He now calls my attention to the fact that Sprengel actually published *Razumovia* for an entirely different group of the Compositae in 1805, not in 1826 as listed in current literature. *Razumovia* Spreng. Allgem. Lit.-Zeit. Intelligenzbl. 136. 1805 is a synonym of *Humea* Smith (1804), but this publication invalidates the use of the same generic name for the very different *Razumovia* Spreng. 1807 = *Centranthera* R. Brown. He has reconsidered the case, abandoning *Razumovia* Spreng. and reinstating *Centranthera* R. Br. for the scrophulariaceous genus.

As explained by Dr. Merrill,[18] *Digitalis cochinchinensis* of Loureiro's "Flora Cochinchinensis" (p. 353) of 1790 antedates *Centranthera hispida* R. Br. of 1810, the name which Schlechter and I have used for the species.

In addition to the two stations cited in 1936 are the following records from the Fly River: Lake Daviumbu, Middle Fly River, common on savannahs, *Brass* 7815; and Gaima, Lower Fly River, in open savannah-forests, common and conspicuous, *Brass* 8270. Both note "flowers yellow."

8. **Buchnera** Linnaeus

*2. **B. urticifolia** R. Br. Prodr. **1**: 437. 1810.

The following collections seem to pertain to this Australasian and East Indo-Malayan species. After citing eight specimens from northeastern and one from southwestern New Guinea and also one from the Bismarck Archipelago, Schlechter states that what he has seen differs from *B. urticifolia* in the usual very thick hairy indumentum of the inflorescence-rhachis and the larger flowers. But our plants from southeastern New Guinea have only moderate or short hairs on the rhachis or are essentially glabrous through the inflorescence, while the flowers are small (8–11 mm. long). Moreover, the corollas are uniformly glabrous externally, and not variable in hairiness as stated by Schlechter. Clearly, there are two species in New Guinea, of which ours accords closely with *B. urticifolia*, the common plant of northern Queensland in northeastern Australia.

Whether our specimens all pertain to the very same species is doubtful. All are recorded as bearing pink flowers. The five collections seen differ as follows, the distinctions being possibly mere local variations or perhaps denoting specific or subspecific trends:

A. Inflorescence throughout finely pubescent.

B. Plant 10–15 dm. tall, the middle cauline leaves ample, 5–7 cm. long, 1–2 cm. wide, the upper abruptly linear-lanceolate. — Lake Daviumbu, Middle Fly River, common on savannahs, *Brass* 7813, in flower Sept., 1936; Gaima, Lower Fly River (east bank), open savannah-forest, occasional in thick grass cover, *Brass* 8253, in flower and fruit Nov. 1936.

BB. Plant 3–4 dm. tall, the middle cauline leaves narrower (largest lost from specimen), the upper rather abruptly smaller. — Urunu, 1500 m. alt.,[19] old artificial grass slope, *Brass* 4821, in flower and fruit Aug., 1933.

[18] Trans. Amer. Philos. Soc. II. **24**: 353. 1935.

[19] Original altitude-record of 2840 m. corrected in Brittonia **3**: 95. 1938.

AA. Inflorescence glabrous, except for minute ciliation of bracts, bractlets and calyx-lobes; plant 5–6 dm. tall, the middle cauline leaves small, narrow, 2–3 cm. long, 0.3 cm. wide, leaves gradually passing from the short wide lower to the subulate upper ones. — Tarara, Wassi Kussa River, Western Division, *Brass* 8571 and 8597, in flower Dec., 1936.

9. **Striga** Loureiro

Apparently the species of this genus show striking contrasts in color, although this is a matter not considered in the old descriptions. Thus, Schlechter's account terms the flowers of *S. lutea* cinnabar-red, of *S. Wallichii* snow-white or very pale yellowish, and of *S. multiflora* brilliant orange-yellow, the last on drying becoming dark bluish gray. L. J. Brass gives the color of the present two species as white and as purple, by the latter of which I suspect violet is really intended. There is urgent need to discover the colors pertaining to the species first described from northeastern Australia, so as to make more use of color-distinctions in this critical group. The following species collected by Brass are closely akin to *S. multiflora* Benth., also originally from northeastern Australia.

Corolla white, 12–15 mm. long, externally pubescent, the throat distinctly wider than the tubes; leaves 2–4 cm. long, the middle ones longer and somewhat spreading. 1a. *S. curviflora*

Corolla violet ("purple"), 7–8 mm. long, externally puberulent, the throat ill-defined though slightly wider than the tube; leaves 1.5–2.5 cm. long, all ascending or the middle ones hardly spreading. 1b. *S. parviflora*

*1a. **S. curviflora** (R. Brown) Bentham, Compan. Bot. Mag. **1**: 362. 1835.

Buchnera curviflora R. Br., Prodr. **1**: 438. 1810.

Gaima, east bank of lower Fly River, open savannah-forest, common in thick grass cover, *Brass* 8256; flower white.

As originally described by Robert Brown this was distinguished from the following by its more elongate and spreading leaves, the retuse upper lip of the corolla, and the upper being only 1/3 the length of the lower corolla-lip. To this Bentham added that the corolla is pubescent. With this characterization our plant agrees except that the upper is about ½ - ⅔ as long as the lower corolla-lip.

In his paper of 1835 Bentham added a related species, *S. multiflora* (p. 313), differing especially in its corolla being glabrous, the upper only little shorter than the lower lip, and in its "long almost decumbent habit." Later, in his Flora Australiensis (**4**: 516. 1869), the two were contrasted wholly as to the corolla-size and -proportions, the corolla of

S. multiflora being "glabrous glandular or pubescent." By this new classification our plant would be *S. multiflora,* but I suspect that actually the pubescence of the corolla externally will prove of sufficient significance to break such an alignment.[20] Accordingly, I am holding our specimen, remarkable for its hairy corolla, as more probably a form of *S. curviflora.*

*1b. **S. parviflora** (R. Brown) Bentham, Compan. Bot. Mag. **1**: 362. 1835.

Buchnera parviflora R. Br., Prodr. **1**: 438. 1810.

Port Moresby, Central Division, open savannah-forest, common on stony hillsides, alt. 200 m., *Brass* 8780; flowers purple.

As originally described by Robert Brown this was distinguished from the foregoing by its strict leaves, the entire upper lip of the corolla, and the upper being ½ the length of the lower lip or slightly more. To this Bentham added that the corolla is pubescent. With this characterization and his subsequent statement of corolla-size,[21] our plant agrees exactly.

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[20]Probably the plant of Northeastern New Guinea, identified by Schlechter as *Striga multiflora* Benth. but said to have bright orange-yellow flowers, will prove to be some other species, as yet undescribed.

[21]Fl. Austral. **4**: 516. 1869.

NEW SPECIES, VARIETIES AND COMBINATIONS FROM THE COLLECTIONS OF THE ARNOLD ARBORETUM

ALFRED REHDER

Abies Ernesti, nom. nov.

Abies firma Masters in Jour. Linn. Soc. Bot. **37**: 422 (1906), non Sieb. & Zucc.

Abies Beissneriana Rehder & Wilson in Sargent, Pl. Wilson. **2**: 46 (1914). — Chun, Chin. Econ. Trees, 30 (1922). — Dallimore & Jackson, Handb. Conif. 87 (1923); ed. 2, 87 (1931). — Rehder in Bailey, Cult. Evergr. 254 (1923); Man. Cult. Trees Shrubs, 32 (1927). — Fitzpatrick in Sci. Proc. Roy. Dublin Soc. **19**: 207 (1929). — Viguié & Gaussen in Bull. Soc. Hist. Nat. Toulouse, **58**: 272 (Rev. Gen. Abies 94) (1929). — Fitschen in Beissner, Nadelholzk. ed. 3, 133 (1930). — Bailey, Cult. Conif. 85 (1933). — Li, For. Bot. China, 30 (1935). — Non Mottet (1902).

Since the name *Abies Beissneriana* Rehd. & Wils. is a later homonym of × *A. Beissneriana* Mottet in Rev. Hort. **1902**: 163, a hybrid of *A. Nordmanniana* and Pinsapo,[1] and therefore not valid, this species may bear the name of its discoverer, Ernest H. Wilson, who introduced it into cultivation in 1904 and again in 1908, but at present it is rare and only a few trees are known to exist in England (cf. Rep. Conif. Confer. Roy. Hort. Soc. pp. 225, 353. 1931), and in France probably raised from seed from "Tnong-Kong," sent in 1924 by the French consul at Chengu-tu (cf. Viguié & Gaussen, l.c.).

Picea notha (*P. Glehnii* [Fr. Schmidt] Mast. ♀ × *jezoensis* var. *hondoensis* [Mayr] Rehd.), hybr. nov.

Arbor habitu *Piceae Glehnii;* ramuli brunnei sparse pilosi, sterigmatibus angulo recto divergentibus 0.75 mm. longis basi tumidis: gemmae conico-ovoideae obtusiusculae, fusco-brunneae, valde resinosae, squamis paucis acuminatis dimidiam gemmam non excedentes, folia ramulorum robustiorum circiter 1.5 cm. longis et circiter 1.25 mm. latis, ramulorum tenuiorum minora, apice abrupte in mucronem obtusiusculum contracta, falcata, ramum supra dense et subadpresse tegentia, subtus fere pectinatim patentia, ventre carinata fasciebus duobus albis e seriebus stomatum 5–7 compositis, dorso lucida laete viridia, leviter obtuseque carinata utrinsecus stomatum seriebus 1–2, rarius 3, partim incompletis notata. Strobili cylindrico-oblongi, 4.5–5.5 cm. longi, im-

[1] = *Abies insignis* Carr. var. *Beissneriana* (Mottet) Rehder in Jour. Arnold Arb. **1**: 54 (1919).

maturi virides, squamis laxe adpressis flexibilibus rhombico-ovatis 1 cm. longis et 7–8 mm. latis leviter striatis et undulatis, apice rotundatis vel supra medium angustatis et truncatis eroso-denticulatis, bracteis triangulari-ovatis circiter 3 mm. longis; semina ala inclusa quam squama triente breviora. Proxima *Piceae jezoensi* var. *hondoensi,* quae facile distinguitur ramulis ochraceis glabris, gemmis bracteis subulatis carentibus, foliis non falcatis, dorso stomatibus destitutis atroviridibus, ventre fasciebus stomatum latioribus magis candidis, strobili squamis angustioribus magis undulatis et erosis apice saepius emarginatis. *Picea Glehnii,* parens feminea, differt ramulis densius pilosis, gemmis basi squamis subulatis gemmae subaequilongis, sterigmatibus brevioribus non tumidis, foliis minoribus 6–12 mm. longis leviter compressis, fasciebus stomatiferis ventre e seriebus stomatum 4–5, dorso 1–3 compositis, strobilis squamis firmis rotundatis, 1–1.4 mm. latis nitidulis margine integro vel vix denticulatis.

Cult. Arnold Arboretum under no. 13406, raised from seed received in 1894 from the Government Forestry School, Tokyo. Specimens in herb.: Coll. *A. Rehder,* April 5, 1917 (sterile); coll. *A. Rehder & E. J. Palmer,* Sept. 28, 1936 (fruiting; type).

From the seed received in 1894 as *Picea Glehnii* about 15 plants were planted, one of which turned out to be the hybrid described above, all the others were true *P. Glehnii.* The seeds must have been collected from a tree or trees growing in the vicinity of trees of *P. jezoenis* var. *hondoensis,* and the flowers partly pollinated by the latter. The tree growing here is about 8 m. tall and is clearly intermediate between *P. Glehnii* and *P. jezoensis* var. *hondoensis,* though in general appearance resembling the latter; from *P. Glehnii* it is easily distinguished by the less pilose branchlets, by the longer sterigmata much thickened at base, the larger compressed leaves with fewer stomatic lines on the dorsal and more numerous lines on the ventral side, and by the cones with flexible, narrower and distinctly erose-denticulate scales; from the latter it differs in the pilose brown branchlets, in the presence of a few stomatic lines on the dorsal side of the leaves and in the broader less undulate cone-scales.

Taxodium distichum (L.) Rich. f. **pendens,** nom. nov.

Taxodium distichum nutans Carrière, Traité Conif. ed. 2, 183 (1867). — Beissner, Handb. Nadelholzk. 152 (1891). — Non *T. d.* var. *nutans* (Ait.) Sweet.

Taxodium distichum pendulum Horsey in Horticulture, Boston, ser. 2, 3: 446, fig. (1925). — Slavin ex Bailey, Cult. Conif. 138 (1933), pro var. — Non *T. d. pendulum* (Endl.) Carr.

A form of typical *T. distichum* with slender pendulous branchlets with the leaves usually somewhat more distant than in the type. This is the form referred to in the remarks under *T. ascendens* f. *nutans* in Jour. Arnold Arb. 7: 22 (1926), where in the citations of synonyms under *T. distichum pendulum,* the reference to Horsey should be eliminated.

Thuja occidentalis f. **Mastersii,** nom. nov.

Thuia plicata Endlicher, Syn. Conif. 51 (1847), pro parte. — Carrière, Traité Conif. 102 (1855), pro parte. — Gordon, Pinet. 325 (1858) *"Thuja,"* ex parte. — Henkel & Hochstetter, Syn. Nadelhölz. 277 (1865), pro parte. — Parlatore in D.C., Prodr. 457 (1868), *"Thuja."*— Beissner, Handb. Nadelholzk. 44 (1891). — Non Lambert (1824).

Thuja occidentalis plicata Wells in Proc. Roy. Hort. Soc. 3: 303 (1863), nom. nud.

Thuya occidentalis var. *plicata* Masters in Gard. Chron. ser. 3, 21: 258 fig. 86 (1897). — Kent in Veitch, Man. Conif. ed. 2, 247 (1900). — Beissner, Handb. Nadelholzk. ed. 2, 504 (1909). — Rehder in Bailey, Cult. Evergr. 223 (1923) *"Thuja"*; Man. Cult. Trees Shrubs (1927). — Dallimore & Jackson, Handb. Conif. 511 (1923) *"Thuja."* — Non Hoopes (1868).

Since *Thuja occidentalis* var. *plicata* Mast. is a later homonym of *Th. occidentalis* var. *plicata* Hoopes, Book Evergr. 321 (1868) a new name is needed for this garden form and it may well bear the name of Masters who first cleared up the existing confusion between this form and the western species. Hoopes' name is based, at least as to the name bringing synonym and the habitat, on *Th. plicata* Lamb., and must stand as the correct name for this tree, if transferred to *Th. occidentalis* as a variety.

Ulmus procera f. **myrtifolia,** f. nov.

Ulmus campestris var. *myrtifolia* Hort. ex Nicholson in Kew Hand-list Trees Shrubs, 2: 135 (1896), nom. nud.; op. cit. ed. 2, 615 (1902); op. cit. ed. 3, 271 (1925), nom. nud.

Ulmus buxifolia Hort. ex Nicholson, l. c., pro synon. praeced.

Ulmus procera var. *myrtifolia* Bean in Kew Hand-list Trees Shrubs, ed. 4, 341 (1934), nom. nud.

Arbor ramis gracilibus. Folia ovata vel rhombico-ovata rarius oblongo-ovata, 2–5 cm. longa, basi obliqua, serrata dentibus simplicibus vel infra denticulo parvo instructa, utrinque laxe pilosis, subtus praecipue ad venas; petiolus 2–4 mm. longus. Fructus obovatus, 12–15 mm. longus; semen apicem clausum attingens.

Kew Arboretum, *Geo. Nicholson,* July 22, 1880 (as *U. myrtifolia* Volxem), type. Hort. Mrs. R. H. Bole, Cleveland, Ohio, June 15, 1927.

This form of *U. porcera* differs chiefly in its small leaves from typical *U. procera*, and in this respect is similar to *U. procera* var. *viminalis* (Loud.) Rehd., but this has longer and narrower, incisely serrate leaves. The second specimen agrees well with the first, but on the more vigorous shoots, the leaves are narrower and longer, up to 5 cm. long, resembling somewhat those of var. *viminalis*, while in the type specimen they are only 2–3 cm. long and always rhombic or rhombic-ovate; the description of the fruit is based on this specimen, the type specimen being sterile. Plants from the tree in Cleveland are growing in this Arboretum.

The plant known as *U. campestris myrtifolia purpurea* DeSmet = *U. procera* f. *purpurascens* (Schneid.) Rehd. has generally larger leaves and is not a purple-leaved variation of the form described above.

Ulmus pumila L. f. **Androssowi** (Litvin.), comb. nov.

Ulmus Androssowi Litvinov in Sched. Herb. Fl. Ross. 8: 23, 202, t. 2 (1922).

Turkestan: city of Samarkand, cult., *Bubyr & Androssov*, March 5, April 18 and July 29, 1913 (Herb. Fl. Ross. no. 2445, isotype, 3 sheets; 3 photos. of type). Taschkent, cult., *Bubyr & Androssov* Feb. 14, March 29, Sept. 11, 1914 (Herb. Fl. Ross. no. 2788).

This form differs from typical *U. pumila* in its very dense spherical crown and also in the pubescent leaves which are usually glabrous in *U. pumila*. It is known only as a cultivated tree and has been much confused with *U. carpinifolia* Gled. var. *umbraculifera* (Trautv.) Rehd. (*U. campestris* var. *umbraculifera* Trautv., *U. turkestanica* Reg., p. p.) which Litvinov cites as pro parte synonyms of his *U. Androssowi*. Both are planted in Turkestan as street trees, sometimes together on the same street, as shown by a photograph taken by Androssov in Samarkand (in Sched. Herb. Fl. Ross. 8: t.2). Though similar in habit, *U. pumila* f. *Androssowi* may be easily distinguished from *U. carpinifolia* var. *umbraculifera* by the grayish or grayish brown bark of the branchlets with conspicuous corky wings on older branches, by the pubescent winter-buds, by the leaves being shallowly and mostly simply serrate, loosely villous beneath and by the suborbicular fruit 10–13 mm. in diam., with the seed slightly above the middle; in *U. carpinifolia* var. *umbraculifera* the branchlets are conspicuously red-brown and do not become corky, the leaves are more sharply and more distinctly doubly serrate, only slightly puberulous beneath when young, soon glabrous, and the obovate fruit is cuneate at base and about 1.5 cm. long, with the seed close to the notch and well above the middle. Sterile specimens of the two elms may not

always be easy to distinguish, but the characters of the fruit are constant and reliable.

Ulmus pumila is very variable in habit and leaf characters. It was originally based by Linnaeus (Sp. Pl. 226) on the shrubby form from Siberia, but Pallas (Fl. Ross. **1:** 76, t.48. 1788) included an arboreous form (fig. D) from southern Russia with it. This plant, however, does not belong to *U. pumila,* but represents *U. carpinifolia* whose range extends from Europe to Transcaucasia and reaches its eastern limit in Turkestan, where *U. pumila* reaches its furthest western extension. One of the first authors to include in *U. pumila* the tree form from N. China was Planchon (in D.C., Prodr. **17:** 159. 1873) and all later authors followed him until Nakai in 1932 (Fl. Sylv. Kor. **19:** 22) separated the tree of Korea, Manchuria and northern China as *U. manshurica;* he also considers the arboreous form of Turkestan, *U. pumila* var. *arborea* Litv., a distinct species for which he adopted the name *U. pinnato-ramosa* Dieck. I cannot see any specific difference between the tree-like and shrubby form; both forms occur in Manchuria and northern China and are probably only ecological variations caused by soil and climatic conditions. Skvortzov in Lingnan Sci. Jour. **6:** 208 (1928) describes a var. *genuina* as a round-topped tree with erect branches and distinguishes three forms based on size and shape of the fruit; in Bull. Jard. Bot. U.R.S.S. **28:** 544 a year later, he describes two more varieties, but rather briefly and as in the preceding publication, without citation of locality or specimens; he does not mention a shrubby form. The form in general cultivation is the tree-like form.

Clematis Armandi Franchet in Nouv. Arch. Mus. Paris, ser. 2, **8:** 184, t.2 (Pl. David. **2:** 2, t.2) (1885). — Finet & Gagnepain in Bull. Soc. Bot. France, **50:** 526 (1903); Contrib. Fl. As. Or. **1:** 11 (1905); in Lecomte, Fl. Gén. Indochine, **1:** 3 (1907). — Rehder & Wilson in Sargent, Pl. Wilson. **1:** 326 (1913), pro parte. — P'ei in Sinensia, **6:** 388 (1935).

Clematis hedysarifolia γ *Armandi* Franch. pr. sp. in msc. ex Kuntze in Verh. Bot. Ver. Brandenb. **26:** 152 (1885, May 28).

Clematis ornithopus Ulbrich in Rep. Spec. Nov. Beih. **12:** 375 (1922).

The type of *C. Armandi* is characterized by a solitary peduncled and leafy inflorescence, and by rather small flowers 2.5–3.5 cm., across with 4 or 5 petals. This form is rather rare and represented in this herbarium by only six specimens from Hupeh, Szechuan, Hunan and Yunnan; also *C. ornithopus* Ulbrich belongs here. Much more com-

mon are the forms with 4 or 5 sepals and leafless panicles. Of this, two forms may be distinguished: one with a solitary peduncled inflorescence represented in this herbarium by three specimens from Szechuan, three from Yunnan, two from Hunan and one from Annam; and one with mostly sessile or subsessile inflorescences represented by three specimens from Hupeh, two specimens from Szechuan and three from Yunnan. The last named form represents a transition to the following variety which has the inflorescence also branching from the base, but has larger flowers about 4–6 cm. across with 5–7, usually 6, broader petals.

Clematis Armandi var. **Biondiana** (Pavol.), comb. nov.

Clematis Armandi Finet & Gagnepain in Bull. Soc. Bot. France, **50**: 526 (1903); Contrib. Fl. As. Or. **1**: 11 (1905), pro parte. — Pampanini in Nuov. Giorn. Bot. Ital. n. ser. **17, 2**: 269 (1910). — Rehder & Wilson in Sargent, Pl. Wilson. **1**: 326 (1913), pro parte. — Sprague in Bot. Mag. **140**: t. 8587 (1914).

Clematis Biondiana Pavolini in Bull. Soc. Tosc. Ort. **32**: 285 (1907); in Nuov. Giorn. Bot. Ital. n. ser. **15**: 401 (1908). — P'ei in Sinensia, **6**: 389 (1935).

This variety differs chiefly in its larger flowers 3.5–6.5 cm. across with 5–6, sometimes 7 sepals; its inflorescence is leafless and sessile, branching from the very base which gives the inflorescence the appearance of several axillary panicles. It is represented in this herbarium by a photograph of the syntype from Sian Men K'vn (Silvestri no. 627), by Silvestri no. 629 and five other specimens from Hupeh; of these Wilson's specimen no. 95 from Chanyang Hsien and an unnumbered Henry specimen differ in the panicles being partly leafy and leafless on the same specimen. This variety is the commonly cultivated form; among the illustrations in horticultural publications which I compared, I found 15 illustrations representing var. *Biondiana* and only two, one by Mottet in Rev. Hort. n. ser. **13**: 65, fig. 18 (1913), and one by Lemperg in Gartenschönh. **9**: 284, fig. (1928) which clearly represent the typical form of *C. Armandi*.

Clematis Armandi f. **Farquhariana** Rehder & Wilson in Sargent, Pl. Wilson. **1**: 327 (1913).

Clematis Armandi var. *Farquhariana* Rehder, Man. Cult. Trees Shrubs, 225 (1927) pro parte, excl. syn. & fig. cit.

This form differs from the preceding variety only in the pale pink color of its flowers. It is represented in this herbarium only by the type specimen and is apparently not in cultivation.

Clematis Armandi grandiflora Mottet in Rev. Hort. n. ser. **17**: 276,

fig. 68 (1921); Arb. Arbust. Orn. 20, fig. 3 (1925), pro var., is probably a hybrid according to Mottet; it has sometimes 5 or 7 leaflets, more coriaceous than in *C. Armandi* and purple when unfolding, while *C. Armandi* has constantly 3-foliolate leaves. Mottet states that the plant was received from La Mortola. There is a specimen under this name received from Hort. Vilmorin in this herbarium with 3-foliolate leaves differing from *C. Armandi* only in the narrowly elliptic sepals overlapping at the base and only 18 mm. long.

Clematis koreana Komar. f. **lutea**, f. nov.

Clematis koreana var. *lutea* [Bean in] Kew Hand-list Trees Shrubs, 68 (1934), nom. nud.

Forma floribus luteis.

Clematis koreana was originally described by Komarov (in Act. Hort. Petrop. **18**: 438. 1904) as varying with yellow flowers in open situations, or with violet flowers in moist and shady situations. There is no indication which he considers typical. In a flowering specimen from Korea (Wilson 8616) the flowers are described as reddish, while in a specimen from Manchuria (Komarov 703) the flowers seems to be yellow. A variety described and figured by Nakai as *C. koreana* var. *umbrosa* (in Matsamura, Icon. Pl. Koishik. **4**: 107, t.266. 1921) is stated to have purple-red flowers. In a cultivated specimen from the Dendrological Garden at Pruhonice, Czechoslovakia, collected 1923, the flower is unmistakably violet, while a cultivated plant figured by F. Lemperg (in Gartenschönh. **9**: 286) is stated to have yellow flowers. Since the yellow-flowered has been separated, at least in gardens, as a distinct form, it seems best to consider the plant with violet or reddish flowers as typical.

Magnolia Wilsonii (Fin. & Gagnep.) Rehd. f. **Nicholsoniana** (Rehd. & Wils.), comb. nov.

Magnolia Nicholsoniana Rehder & Wilson in Sargent, Pl. Wilson. **1**: 394 (1913). — Wilson in Jour. Arnold Arb. **7**: 235 (1926). — Millais, Magnolias, 178 (1927). — Rehder, Man. Cult. Trees Shrubs, 255 (1927).

Magnolia taliensis W. W. Smith in Notes Bot. Gard. Edinb. **8**: 341 (1915).

Magnolia liliifera var. *taliensis* Pampanini in Bull. Soc. Tosc. Ort. ser. 4, **1**: 137 (1916).

Magnolia Wilsonii (Fin. & Gagnep.) Dandy in Notes Bot. Gard. Edinb. **16**: 126 (1928), pro parte, quoad synon. *M. Nicholsoniana* et *M. taliensis*.

Specimens examined: Szechuan, *E. H. Wilson* 838 (type of

M. Nicholsoniana); Yunnan, *G. Forrest* 15476, *J. F. Rock* 8620, 8639, *S. Ten* 302, 564.

This form differs from *M. Wilsonii* in its leaves being glaucescent and glabrescent beneath except the rufous-pilose midrib, while *M. Wilsonii* has the underside of the leaves densely covered with long subappressed white silky hairs. The latter is represented in this herbarium by the following specimens: Szechuan: *Wilson* 1374 and Veitch Exp. 3137, *Harry Smith* 1953; Yunnan: *S. Ten* 500, 593; also by several cultivated specimens. According to Dandy the material from Yunnan displays all intermediate degrees of hairiness; one of these intermediate forms is represented by Ten 593 which has the mature leaves only slightly and thinly pubescent. Intermediate forms, however, seem to be rare, and as the dense silky pubescence of the underside of the leaves gives the foliage quite a distinct aspect from that of the glabrescent form, it seems desirable, particularly from a horticultural point of view, to keep the glabrescent plant distinct, at least as a form.

Lindera aestivalis (L.) Bl. f. **xanthocarpa** (G. S. Torr.), comb. nov.

Benzoin aestivale f. *xanthocarpum* G. S. Torrey in Rhodora, **16**: 91 (1914).

Since the proposition to conserve *Lindera* Thunb. against *Benzoin* Fabric. had the majority of votes of the Special Nomenclature Committee for Phanerogamae and Pteridophyta appointed in 1935 by the International Botanical Congress, a new combination is necessary for the yellow-fruited form published under *Benzoin aestivale*.

Hydrangea serrata f. **prolifera** (Reg.), comb. nov.

Viburnum cuspidatum Thunberg, Fl. Jap. 125 (1785).

Hydrangea stellata Siebold & Zuccarini, Fl. Jap. **1**: 112, t. 59 (1840).

Hydrangea stellata β prolifera Regel in Gartenfl. **25**: 291, t. 521 (1866).

Hydrangea cuspidata Miquel in Ann. Mus. Bot. Lugd.-Bat. **3**: 98 (1867). — Koidzumi in Bot. Mag. Tokyo, **39**: 311 (1925).

Hydrangea opuloides var. *prolifera* Rehder in Bailey, Stand. Cycl. Hort. **3**: 1622 (1915).

Hydrangea serrata var. *stellata* Wilson in Jour. Arnold Arb. **4**: 245 (1923), which see for further citations of synonyms and literature.

Hydrangea cuspidata (Thbg.) Miq. var. *japonica* (Sieb.) Koidzumi in Bot. Mag. Tokyo, **39**: 311 (1925), pro parte.

Wilson when making the combination *H. serrata* var. *stellata* overlooked the fact that the oldest varietal epithet of this plan is "*prolifera*."

Viburnum cuspidatum Thunb. of which I examined the type and photographed it when in Uppsala in 1928, is referable to this form,

since it has all the flowers sterile, though the leaves are somewhat different being more sharply and closely serrate with a somewhat slenderer acumen than those of *Viburnum stellatum* α of Thunberg's herbarium which also represents this form and agrees more closely with the plant cultivated as typical "*stellata*" and with Regel's plate of *H. stellata* var. *prolifera*.

Koidzumi in 1912 (in Bot. Mag. Tokyo, **26:** 388) had identified *Hydrangea cuspidata* (Thunb.) Miq. with *H. involucrata* Sieb. and quoted the latter as a synonym of the former, but changed his opinion in 1925 after he had seen Thunberg's type; however, he did not pay any attention to the fact that *Viburnum serratum* and *V. cuspidatum* represent garden forms with all the flowers sterile.

Liquidambar Styraciflua L. f. **pendula,** f. nov.

A typo recedit ramis pendulis; arbor trunco excurrente ramis deflexis longis pendulis comam angustam formantibus.

This interesting new form was discovered near Hatton, Arkansas, about 1935 by Miss Sara W. Crawford. Only a single tree was found, of which Miss Crawford kindly sent us a leafy branch and photographs of the whole tree in summer and winter condition, (specimen coll. Sara W. Crawford, Oct. 9, 1938, and three photographs in herb. Arnold Arb.). We are also obliged to her for pieces of living root, from which we hope to propagate this tree. The tree observed is about 18 m. tall with a slender trunk about 23 cm. in diameter breast high; the straight upright trunk bends over at the top for about 3 m. and is clothed to the ground with deflexed pendulous branches of nearly equal length forming a slender narrow crown.

Of another interesting form of the sweet-gum, *L. Styraciflua* f. *rotundiloba Rehd.* (in Jour. Arnold Arb. **12:** 70, 1931) we have been promised a young plant by the discoverer Mr. R. E. Wicker of Pinehurst, N. C., so that we may hope to have both these interesting forms growing in this arboretum.

A third form described as *L. Styraciflua suberosa* Schwerin (in Mitt. Deutsch Dendr. Ges. **45:** 390, pl. 52. 1933) with all the branches strongly corky-winged is hardly worth distinguishing, since it represents the typical form of the tree, perhaps with the corky wings somewhat more strongly and plentifully developed than usual.

Spiraea virgata Franchet, Pl. Delavay. 199 (1890).

Spiraea myrtilloides Rehder in Sargent, Pl. Wilson. **1:** 440 (1913); Man. Cult. Trees Shrubs, 337 (1927). — **Synon. nov.**

When I had the opportunity to examine in the Paris herbarium the

types of Franchet's new species of *Spiraea,* I found that his *Spiraea virgata* agrees well with the species I had described in 1913 as *S. myrtilloides.* Additional material received later shows that the species is widely distributed in western Szechuan and in Yunnan and that it is very variable, particularly in its inflorescence which may be nearly sessile or borne on a very short lateral branchlet with few leaves at the base, or on an elongated leafy branchlet up to 4 cm. long; it may be glabrous or pubescent and may be a simple raceme with occasionally two flowers on one pedicel or the inflorescence may become corymbose with the lateral axes bearing 1–5 flowers. Such specimens approach *S. Schneideriana* Rehd. which is probably only an extreme variety of *S. virgata,* as I have already indicated under *S. Schneideriana* var. *amphidoxa* (op. cit. **1**: 450).

Cotoneaster microphylla Lindl. f. **melanotricha** (Franch.), comb. nov.

Cotoneaster buxifolia Wall. f. *melanotricha* Franchet, Pl. Delavay. 224 (1890).

YUNNAN: Hee-chan-men, *Delavay* 3742 (type; photo. and fragments in herb. Arnold Arb.); near Tali, alt. 3000 m., *C. Schneider* 2800, Oct. 16, 1914; eastern slopes of Likiang Snow Range, *J. F. Rock* 3460, May to Oct. 1922. Cult. Nursery Overrieden, Switzerland, June 1, 1938, raised from seed coll. by C. Schneider in 1914.

This variety was originally placed by Franchet under *C. buxifolia* Lindl., but differs in its glaucous papillose underside of the leaves furnished with scattered blackish hairs. It is perhaps only a form of *C. microphylla* var. *cochleata* (Franch.) Rehd. & Wils. from which it differs apparently only in its blackish hairs.

Sorbus hybrida L. var. **Meinichii** (Hartm.), comb. nov.

Sorbus Aucuparia Meinichii* Lindeb. mskr. ex Hartman, Handb. Skand. Fl. ed. 11, 271 (1879). — Hjelt in Act. Soc. Faun. Fl. Fenn. **41, 1**: 23 (Consp. Fl. Fenn.) (1919).

Sorbus Meinichii Hedlund in Svensk. Vetensk.-Akad. Handl. **35, 1**: 49, fig. 8 (Monog. Sorbus) (1901). — Schneider, Ill. Handb. Laubholzk. **1**: 675, fig. 370g (1906). — Blytt, Handb. Norges Fl. 420 (1906).

Pyrus aucuparia × (*aucuparia* × *intermedia*) Ascherson & Graebner, Syn. Mitteleur. Fl. **6, 2**: 105 (1906).

Sorbus aucuparia × *fennica* Lindman, Svensk Fanerogamfl. 305 (1918).

Since *Sorbus Meinichii* is generally considered as having originated as a cross between × *S. hybrida* with one of its parents, it must be classed as a variety of the binomial which stands for that group of hybrids; special binary names for different forms of the same parentage are not allowed under the International Rules.

Sorbus intermedia (Ehrh.) Pers. var. **arranensis** (Hedl.), var. nov.

Pyrus fennica Syme, Sowerby's Engl. Bot. ed. 3, **3**: t. 485 (1864), non *P. fennica* (L.) Babington (1851).

Sorbus arranensis Hedlund in Svensk. Vetensk.-Akad. Handl. **35**, **1**: 60, fig. 12–14 (Monog. Sorb.) 1901. — Marshall in Jour. Bot. **54**: 10 (1916).

This variety is similar to *S. intermedia* var. *minima* (Ley) Bean, but the leaves are larger and more deeply divided, the lowest sinuses reaching more than halfway to the middle.

× **Sorbaronia Jackii** (*Aronia prunifolia* × *Sorbus americana*), hybr. nov.

Frutex, ramulis initio adpresse albo-villosis; folia infra pinnata pinnis 2–4 plerisque oblongis decurrentibus acutis vel acutiusculis serratis, superius lobata, apicem versus argute serrata, supra in costa sparse glandulosa, subtus villosa, glabrescentia, ea ramulorum florentium 3–7 cm. longa, apice acuta vel acutiuscula, interdum pauca simplicia vel tantum lobata, ea ramulorum sterilium ad 10 cm. longa et oblongo-lanceolata, manifeste acuminata; petioli 1–2 mm. longi, villosi. Inflorescentia satis densa, 3–4 cm. diam., laxe vel sparse villosa; calyx glaber vel fere glaber. Fructus ovoideus, circ. 8 mm. longus, atropurpureus.

Nova Scotia: Halifax, near entrance to Pt. Pleasant Park, *J. G. Jack* 677, June 16, 1918, no. 3242, June 21 and Sept. 30, 1924. Cult. in Arnold Arboretum under no. 18262 from plants introduced by J. G. Jack in 1924; specimens in herb. A.A.: Sept. 23, 1927, Sept. 25, 1929, May 16, 1930, May 22, 1933, May 11 and July 23, 1936.

This plant is apparently a hybrid between *Sorbus americana* Marsh. and *Aronia prunifolia* (Marsh.) Rehd. (*A. floribunda* Lindl., *A. atropurpurea* Britt.) which both grow on the island. Besides these species, *Aronia melanocarpa* (Willd.) Ell. and *Sorbus aucuparia* L. are found there, the latter naturalized. The villous pubescence of the underside of the leaves and of the inflorescence excludes the former and the acuminate leaves and the small inflorescence and small fruit the latter as possible parents of this hybrid.

Photinia villosa f. **Maximowicziana** (Lévl.), comb. nov.

Pirus sinensis Lindl. var. *Maximowicziana* Léveillé in Rep. Spec. Nov. **10**: 377 (1912).

Photinia villosa "(Thunb.) D. C." Rehder in Jour. Arnold Arb. **13**: 304 (1932) quoad synon. supra cit.

Korea: Quelpaert, in sylvis Haitchenam, *E. Taquet*, 2821, Aug. 1909 (holotype of *Pirus sinensis* var. *Maximowicziana*, photo. and iso-

type); in sepibus Spalkai [?], *E. Taquet* 1456, Oct. 30, 1908. Cult. Golden Gate Park, *E. Walther*, Sept. 10, 1928; Atlantic Nurseries, Berlin, Md., Nov. 3, 1937; Sunridge Nurseries, Greenwich, Conn., Oct. 13, 1938; Arnold Arboretum, no. 507 (plant received in 1879 from Parsons & Son who introduced it from Japan), June 11 & Oct. 1887, Oct. 20, 1890 and Oct. 13, 1892.

This form differs from type chiefly in the following characters: Leaves obovate, rounded and abruptly acuminulate or nearly truncate at apex, gradually narrowed at base into a petiole 1–2 mm. long, chartaceous, serrulate or ciliate-denticulate, midrib and veins above much impressed, elevated beneath, often rugulose above and veinlets prominent beneath, at maturity sparingly villous on the under surface or only near midrib beneath, sometimes nearly glabrous; inflorescence villous, at maturity sparingly villous (in the type specimen) or glabrous. With its subcoriaceous strongly veined leaves distinctly obovate and mostly rounded or nearly truncate at the apex, this variety looks quite distinct from the typical plant. The two numbers 507 and 2902 cultivated at the Arnold Arboretum have the leaves less strongly rounded at the apex and never truncate, and approach the typical plant.

× **Malus purpurea** (Barbier) Rehd. f. **Lemoinei** (Lemoine), comb. nov.

Malus floribunda Lemoinei Lemoine, Cat. no. **196**: 11 (1932).

Pyrus Lemoinei R. C. Notcutt ex Gard. Chron. ser. 3, **83**: 343, fig. 165 (p. 349) (1928).

This is apparently a form of *Malus purpurea* which is a hybrid between *M. pumila* var. *Niedzwietzkyana* (Dieck) Schneid. and × *M. atrosanguinea* (Spaeth) Schneid. It was raised by Lemoine and first mentioned in his Catalogue as cited above with a brief description. It is growing in this Arboretum and with its dark bronzy leaves and deep crimson flowers, is the most attractive of the group of hybrids belonging to *M. purpurea*.

Malus prunifolia (Willd.) Borkh. f. **pendula** (Bean), comb. nov.

Pyrus prunifolia Willd. var. *pendula* Bean, Trees Shrubs Brit. Isls. **2**: 291 (1914).

A form with pendulous branches in cultivation in the Kew Arboretum from which this Arboretum received scions for grafting in 1926.

Pyrus pyrifolia (Burm.) Nakai f. **Stapfiana** (Rehd.), comb. nov.

Pyrus sinensis sensu Stapf in Bot. Mag. **134**: t. 8226 (1908) pro parte, quoad plantam depict.; non Lindl.

Pyrus serotina var. *Stapfiana* Rehder in Proc. Am. Acad. Arts Sci. **50**: 233 (1916).

Since Nakai has shown that *Ficus pyrifolia* Burmann of which he saw the type specimens in the herbarium Delessert at Geneva, is an older name for *P. serotina* Rehd., the above new combination becomes necessary for this form distinguished by rather small pyriform fruit.

Pyrus Regelii, nom. nov.

Pyrus heterophylla Regel & Schmalhausen in Act. Hort. Petrop. **5**: 581 (1878), non Pott (1800), nec (Spach) Steud.

The name *P. heterophylla* Reg. & Schmalh. which fits this species with partly entire, partly pinnatifid to pinnatisect or trifid leaves very well, has unfortunately two older homonyms which make the name untenable, although the homonyms belong to different genera.

Pyrus heterophylla Pott in Du Roi, Harbk. Baumz. ed. 2, 318 (1800) is evidently a renaming of *P. hybrida* Moench and becomes a synonym of *Sorbaronia hybrida* (Moench) Schneider in Silva-Tarouca, Uns. Freiland-Laubgeh. ed. 2, 388 (1922). As author of *P. heterophylla* usually Du Roi is cited, but the second edition was issued after the death of Du Roi by his friend J. F. Pott who made additions to the original text indicated by being enclosed in brackets (cf. op. cit. pref. p. XI): *Pyrus heterophylla* is such an addition.

Pyrus heterophylla (Spach) Steudel, Nomencl. ed. 2, **2**: 423 (1841) is based on *Malus heterophylla* Spach, Hist. Veg. **2**: 138 (1834) which probably is, as suggested by Spach, a hybrid between *Malus pumila* and *M. coronaria,* as is also the opinion of Schneider (cf. Ill. Handb. Laubholzk. **1**: 719) who saw Spach's type. *Malus heterophylla* would then be the oldest name for this hybrid which also has originated independently in America and has often been confused with *Malus Soulardii* Brit. Here belongs "Matthew's Crab" and some other forms usually referred to *M. Soulardii.*

Potentilla fruticosa L. f. **Wardii,** nom. nov.

Potentilla fruticosa var. *grandiflora* Marquand in Jour. Linn. Soc. Bot. **48**: 175 (1929); non Willd. (1816).

Since the epithet given by Marquand is preoccupied by *P. fruticosa β. grandiflora* Willd. in Mag. Naturf. Fr. Berlin, **7**: 285 (1816), it must be changed and I propose to name it for the collector, Mr. F. Kingdon Ward.

Potentilla fruticosa var. **Friedrichsenii** (Spaeth) Rehd. f. **Beanii,** nom. nov.

Potentilla Friedrichsenii leucantha Spaeth in Mitt. Deutsch. Dendr. Ges. **19**: 286 (1910); Rep. Spec. Nov. **13**: 365 (1914).

Potentilla fruticosa var. *leucantha* Bean, Trees Shrubs Brit. Isls. **2**: 223 (1914). — Rehder, Man. Cult. Trees Shrubs, 423 (1927). — Non Makino (1910).

This white-flowered form is a seedling of var. *Friedrichsenii* which is a hybrid between typical *P. fruticosa* and var. *dahurica* (Nestl.) Ser. If *P. davurica* Nestl. is considered a distinct species, the binary name × *P. Friedrichsenii* Spaeth is the valid name for this hybrid and *"leucantha"* can stand as the name of a subdivision of this hybrid, but if transferred as a subdivision to *P. fruticosa,* it is invalidated by *P. fruticosa* var. *leucantha* Makino (in Bot. Mag. Tokyo, **24**: 32. 1910) which belongs to var. *mandshurica* Maxim.

Rosa pendulina L. var. **oxyodon** (Boiss.), comb. nov.

Rosa oxyodon Boissier, Fl. Or. **2**: 674 (1872). — Crépin in Bull. Herb. Boiss. **2**: 261 (1895).

Rosa alpina var. *oxyodon* (Boiss.) Boulenger in Bull. Jard. Bot. Bruxelles, **13**: 244 (1935).

Following R. Keller (in Ascherson & Graebner, Syn. Mitteleur. Fl. 6, **1**: 299. 1902) and others, I take *R. pendulina* to be the oldest name applicable to this species.

Rosa carolina L. var. **villosa** (Best) Rehd. f. **alba** (Rehder), comb. nov.

Rosa lucida var. *alba* Anon. in Am. Florist, **12**: 1098, fig. (1897). — Rehder in Bailey, Cycl. Am. Hort. **4**: 1554 (1902).

Rosa virginiana alba Willmott, Gen. Rosa, **1**: t. opp. p. 198 (1911).

Rosa Lyoni Pursh f. *alba* Rehder in Jour. Arnold Arb. **3**: 17 (1921) which see for further citations.

Since *R. Lyoni* Pursh is hardly separable from *R. carolina* as a distinct species, this white-flowered form which is undoubtedly a form of *R. Lyoni* must be classed under *R. carolina.*

Rosa chinensis Jacq. f. **mutabilis** (Corr.), f. nov.

Rosa mutabilis Correvon in Rev. Hort. **1934**: 60, pl.

This rose differs from *R. chinensis* chiefly in the color of the flowers which change from sulphur-yellow to orange and red and finally to crimson. The flowers are simple, 4.5–6 cm. across, with obovate petals; the leaflets are mostly oblong-ovate gradually acuminate and on the specimens before me up to 5 cm. long, those of the flowering branchlets smaller and comparatively broader. In the orange and yellow shades of the flowers, it resembles certain forms of *R. odorata* Sweet, but in all other characters it agrees with *R. chinensis.*

Prunus Amygdalus Batsch f. **variegata** (Schneid.), comb. nov.

Amygdalus communis foliis variegatis F. J. Schultz, Abh. Bäume Oestr. **1**: t. 24 (1792) ex Ind. Lond. **1**: 174. — Baum. Cat. ex Loudon, Arb. Frut. Brit. **2**: 675 (1838).

Prunus communis f. *variegata* hort. ex Zabel in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 235 (1903), nom. — Schneider, Ill. Handb. Laubholzk. **1**: 593 (1906).

A form with variegated leaves, apparently already known before 1800.

Prunus Amygdalus f. **purpurea** (Schneid.), comb. nov.

Prunus communis f. *purpurea* hort. ex Zabel, l. c. (1903), nom. — Schneider l. c. (1906).

A form with rose-purple flowers.

Prunus Amygdalus f. **roseo-plena** (Schneid.), comb. nov.

Amygdalus communis flore pleno F. J. Schultz, Abh. Bäume Oestr. **1**: t. 25 (1792) ex Ind. Lond. **1**: 174. — Baum. Cat. ex Loudon, l. c. (1838). — Carrière in Rev. Hort. **1875**: 370, t.

Prunus communis f. *rosea plena* Zabel, l. c. (1903), nom.

Prunus communis f. *roseo-plena* Schneider, l. c. (1906).

A form with double pink flowers, like the preceding known already before 1800.

Prunus Amygdalus f. **albo-plena** (Schneid.), comb. nov.

Prunus communis f. *alba plena* Zabel, l. c. (1903), nom.

Prunus communis f. *albo-plena* Schneider l. c. (1906).

A form with double white flowers.

Prunus tomentosa f. **leucocarpa**, f. nov.

A typo recedit fructibus albidis.

This form differing in its yellowish white fruits is growing in the Arnold Arboretum, plants having been presented to the Arboretum by Mr. H. P. Kelsey of East Boxford, Mass., in 1930. Specimens in herbarium Arnold Arboretum; coll. July 25, 1931 (fruit) and April 28, 1936 (flowers).

× **Prunus Skinneri** (*P. japonica* ♀ × *tenella*), hybr. nov.

Frutex ramulis brunneis, cortice tertio anno longitudinaliter fisso. Folia oblongo-ovata vel oblongo-lanceolata, 3.5–5.5 cm. longa, acuminata, basi late cuneata, interdum fere rotundata, argute subsimpliciter serrulata, dentibus mucronulatis partim denticulo unico instructis, supra sparse minuteque adpresse pilosula praesertim marginem versus, subtus ad costam pilosula, ceterum glabra; petioli puberuli 2–4 mm. longi. Flores coetanei, 2–3; pedicelli 1–2 mm. longi, puberuli ut calyx;

calycis tubus anguste campanulatus circiter 3 mm. longus; sepala tubum subaequantia vel paullo longiora, oblonga, reflexa, glanduloso-denticulata, intus extusque puberula; petala obovato-oblonga vel oblonga, supra medium dentata; stamina petalis dimidiis breviora; stylus petalis paullo brevior, in triente inferiore longe pilosus; ovarium minute dense pubescens. Fructus ovoideus, circ. 1 cm. longus, dense subadpresse villosus.

Cult. Manitoba Hardy Plant Nursery, coll. *F. L. Skinner*, spring 1938 (flower; type), Aug. 25, 1938 (fruit) (in herb. Arnold Arboretum).

This hybrid was raised by Mr. F. L. Skinner from seed of *P. japonica* Thunb. It is easily distinguished from that species by the narrower nearly simply serrate leaves, broadly cuneate at base with longer petioles, the very short pedicels, the narrow-campanulate calyx, narrower sepals and petals, the pilose style and the pubescent ovary and fruit. From *P. tenella* Batsch (*P. nana* Stokes, not Du Roi) it differs chiefly in the ovate-oblong, acuminate, closely and slightly doubly serrulate leaves, pubescent on the midrib beneath, in the short-stalked flowers and in the campanulate calyx.

× **Prunus Schmittii** (*P. canescens* ♀ × *avium*), hybr. nov.

Arbor parva, ramis erecto-patentibus cortice trunci rubro-brunneo, lenticellis magnis transversis, cortice ramorum in lamellas tenues solubili, ramulis hornotinis satis dense villosulis, annotinis rubro-fuscis glabris nitidulis. Folia elliptico-oblonga, 5–8 cm. longa, acuminata, basi late cuneata, dupliciter vel subsimpliciter serrata dentibus obtusiusculis, supra initio laxe adpresse pilosa, demum glabrescentia, subtus dense pilosa praecipue ad nervos, demum in facie sparse ad costam et venas laterales densius pilosa; petioli 1–2.5 cm. longi, graciles, initio pilosi, demum fere glabri. Flores 1–3, basi involucro sub anthesi persistente circumdata; pedicelli 1–1.5 cm. longi, sparse pilosi; calycis tubus campanulatus, 5–6 mm. longus, laxe pilosus; sepala ovata vel ovalia, circiter 2 mm. longa, fere integra, extus laxe pilosa, intus glabra, patentia vel reflexa; petala late ovalia vel obovato-orbicularia, alborosea, 9–10 mm. longa; stamina dimidia petala aequantia; stylus glaber, stamina paullo superans. Drupa subglobosa, circ. 1 cm. diam., putamine laevi ovoideo.

Cult. in Arnold Arb.: no. 1548–23, coll. *A. Rehder*, June 3, 1935 (fruit) and May 10, 1937 (flowers; type).

This hybrid was raised in 1923 from seed of *P. canescens* Bois, from which it is at once distinguished by its tree-like habit, the much larger, less pubescent leaves on longer petioles, by the larger flower with campanulate calyx, broadly oval petals about 1 cm. long and by longer

pedicels surrounded at the base by a large conspicuous involucre. In its general aspect it approaches *P. avium* L., particularly in the serration and shape of the leaves, the campanulate calyx and the rather large flowers surrounded by a conspicuous involucre, but it is easily distinguished by the sparsely flaky bark of the branches, the pubescent branchlets, the persistent pubescence of the underside of the leaves and by the pilose pedicels and calyx. There are several trees of this hybrid growing in the Arboretum, now about 5 m. tall.

I take pleasure in naming this handsome hybrid after the superintendent of the Arnold Arboretum, Mr. Louis V. Schmitt, who has been connected with the Arnold Arboretum for 33 years.

Arnold Arboretum,
Harvard University.

ADDITIONAL NOTES ON CHINESE MYRTACEAE

E. D. MERRILL and L. M. PERRY

IN THE regular routine of naming collections received since the publication of The Myrtaceae of China,[1] we have noted the following range-extensions and additional species.

Baeckea frutescens Linn. var. **brachyphylla** var. nov.

A forma typica differt foliis latioribus obtusisque, 4–6 mm. longis.

KWANGSI: without definite locality, *Wang 39952*.

Although *Wang 39952* (collection in fruit only) may be specifically distinct, we are designating it as a variety of *B. frutescens* L. distinguished by blunt leaves rarely more than 6 mm. long and usually 1 mm. broad. The typical form of the species is characterized by pointed leaves 6–10 mm. (or more) long and 0.5 mm. broad.

Syzygium latilimbum (Merr.) Merr. & Perry, Jour. Arnold Arb. **19**: 216. 1938.

YUNNAN: Fo-Hai, *Wang 74649;* Meng-ban, Shan-hsien, Fo-hai Hsien, *Wang 76203;* Dah-meng-lung, Che-li Hsien, *Wang 76343, 77877;* Sheau-meng-yeang, Che-li Hsien, *Wang 75837;* You-louh-shan, Che-li Hsien, *Wang 78148;* Kuen-ger, Che-li Hsien, *Wang 79217;* Lan-Tsang Hsien, *Wang 76538, 76691;* Tsang-Yuan, *Wang 73283*.

Previously reported from Hainan with one collection from Yunnan as possibly representing the same species.

Syzygium Nienkui Merr. & Perry, op. cit. 228.

KWANGSI, without definite locality, *Wang 39029*. Hainan.

Syzygium oblatum (Roxb.) A.M. & J.M. Cowan, Trees North. Bengal 68. 1929; Merr. & Perry, Jour. Arnold Arb. **19**: 101. 1938 (Wall. List, no. 3569. 1831, *nomen nudum*).

Eugenia oblata Roxb. Fl. Ind. ed. 2, **2**: 493. 1832; Kurz, For. Fl. Brit. Burma **1**: 488. 1877; Duthie in Hooker f. Fl. Brit. Ind. **2**: 492. 1878; King, Jour. As. Soc. Bengal **70** (2): 114. 1901; Craib, Fl. Siam. Enum. **1**: 652. 1931.

Eugenia reticulata Wight, Ill. **2**: 16. 1841, Ic. **2**: *t. 541*. 1843.

Syzygium reticulatum Walp. Repert. **2**: 179. 1843.

[1] Jour. Arnold Arb. **19**: 191-247. 1938.

YUNNAN: Fo-Hai, *Wang 76125*, July, 1936, at 1300 m. alt.; Meng-pung, Jenn-yeh Hsien, *Wang 80408*, October, 1936, at 800 m. alt.; Che-li Hsien, *Wang 75557*, August, 1936, at 950 m. alt.; Maan-bang, Dah-meng-lung, Che-li Hsien, *Wang 77440*, at 980 m. alt.

Type from Chittagong. Indo-China, Annam, Burma, Siam, the Malay Peninsula and Borneo.

By scanning our herbarium collections from India for species which might also occur in Yunnan, we found three specimens (*Prain's collector 799, King's collector s. n.*, and no. *11161* collected by the Reporter on Economic Products to the Government of India), labeled *Eugenia reticulata* Wight, which agree very well with our somewhat fragmentary Yunnan material. These also do not appear to be separable from the more widely known *E. oblata* Roxb. *Eugenia reticulata* Wight has long since dropped into synonymy.

Syzygium Thumra (Roxb.) comb. nov.

Eugenia Thumra Roxb. Fl. Ind. ed. 2, **2**: 495. 1832; Wight, Ic. **2**: *t. 617*. 1843; Kurz, Jour. As. Soc. Bengal **46**(2): 67. 1877, For. Fl. Brit. Burma **1**: 488. 1877; Duthie in Hook. f. Fl. Brit. Ind. **2**: 481. 1878; Brandis, Ind. Trees 321. 1906.

Syzygium speciosum Wall. List, no. 3568. 1831 (fide Duthie), *nomen nudum*.

YUNNAN: Dah-meng-lung, Che-li Hsien, *Wang 77665*, August, 1936, at 950 m. alt.; Meng-pung, Jenn-yeh Hsien, *Wang 78930*, October, 1936, at 800 m. alt.

Type from Pegu, Burma.

This is only a tentative determination to call attention to these two fruiting collections. All our material from India is in flower. Although the leaves, the petioles and the bark of the branches compare favorably in both the Indian and the Chinese specimens, the difficulty of matching with any degree of surety flowering and fruiting collections even from neighboring regions is great and must always be borne in mind.

Syzygium Bullockii (Hance) Merr. & Perry, op. cit. 107, 238.

KWANGSI: *Liang 70107*. Kwangtung, Hainan, Indo-China.

Syzygium euonymifolium (Metcalf) Merr. & Perry, op. cit. 242.

KWANGSI, *Liang 69921*. Kwangtung.

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A REVIEW AND EXTENSION OF OUR KNOWLEDGE OF CALYPTOSPORA GOEPPERTIANA KUEHN

J. H. FAULL

OUR KNOWLEDGE of the haploid phase of *Calyptospora Goeppertiana* on *Abies* dates from 1805 and of the diploid phase on *Vaccinium* from 1869. That the latter was not recognized earlier is readily understood because there are no uredia, and because the teliospores are intraepidermal with no suggestive external indications of their presence. In 1880, Robert Hartig (13) announced that he had proved the connection of the two phases by means of culture experiments. His findings have been confirmed repeatedly.

Calyptospora Goeppertiana is of special interest not only for its lack of uredia but also for its reduced spermogonia. Indeed, the latter were long supposed to be absent. They do occur, however, and often in considerable numbers. But they are aborted to a greater or less extent and, so far as Hunter (15) could determine from a thorough study of the rust on *Abies balsamea,* they do not form spermatia nor do they rupture. On the other hand, Weir (21) reported normal spermogonia and spermatia for *C. Goeppertiana* on *A. lasiocarpa.* If that occurrence is representative for the rust in western North America, then it differs from what is known of it in Europe and eastern North America. Before re-defining the species, however, Weir's observations should be checked against those made on unquestionably authentic *C. Goeppertiana,* preferably from cultures on *A. lasiocarpa* in which telial material from Europe or eastern North America would be used as inoculum.

Another feature of interest concerning *C. Goeppertiana* is its phylogeny. Plainly, as has been maintained by Faull (9) and others, the characteristics of its spermogonia, aecia and teliospores suggest a close relation to *Pucciniastrum.* From a comparative investigation of the ontogeny of the teliospores in the various genera of the Pucciniastreae, Pady (19), while recognizing the resemblance of *Calyptospora* to *Pucciniastrum,* inclines to the view that they may be analogous genera in parallel evolutions. He concludes — "These results agree in a very general way with the phylogenetic tree that Faull has constructed for the *Pucciniastreae,* except for the possibility that the two lines of development indicated above might represent two phylogenetic series. In that case,

the phylogenetic tree would possess two main branches, the one leading through the intra-epidermal forms, *Milesia, Hyalopsora, Thecopsora* and *Calyptospora,* and the other passing through the subepidermal genera *Pucciniastrum* and *Melampsoridium,* to such forms as *Melampsora.* Many more data would be necessary, however, before this series could be postulated as a phylogenetic one."

Economically, *C. Goeppertiana* is probably not of great importance. Yet I have found it on seedlings of *Abies balsamea* in the forest in such abundance as to indicate some effect on the natural reproduction of that species. Weir (21) also reports that in the western United States it is injurious to various species of *Vaccinium.* But so far no exact investigation seems to have been made on that aspect of the rust.

This paper deals with four topics relative to *C. Goeppertiana,* namely, (1) nomenclature and taxonomy, (2) life history studies, (3) hosts, (4) specimens examined.

NOMENCLATURE AND TAXONOMY

Calyptospora Goeppertiana Kühn in Hedw. **8:** 81 (1869). (III).

Aecidium columnare Albertini & Schwein. Consp. Fung. Lusat. 121 (1805). (I).

Peridermium columnare Kze. & Schm. Deutschl. Schwämme no. 10 (1815). (I).

Caeoma columneum Link in W. Spec. Pl. **6, 2:** 66 (1825). (I).

Uredo columnaris Spreng. Syst. Veg. **4, 1:** 570 (1827). (I).

Melampsora Goeppertiana Wint. in Rabenhorst, Krypt.-Fl. ed. 2. **1:** 245 (1884).

Melampsora columnaris Wettst. in Verhandl. Zool.-Bot. Ges. Wien, **35:** 551 (1885).

Calyptospora columnaris Kühn in Rabenh.-Wint. Fung. Eur. no. 3521 (1886).

Pucciniastrum Goeppertianum Kleb. Wirtswechs. Rostpilze, 391 (1904).

Thecopsora Goeppertiana Hiratsuka in Jour. Soc. Agric. Forestr. Sapporo, **19:** 167 (1927).

After it was experimentally demonstrated that *Aecidium columnare* A. & S. on *Abies* and *Calyptospora Goeppertiana* Kühn on various species of *Vaccinium* are the haploid and the diploid phases, respectively, of the same species, the nomenclatural history of this rust has mainly revolved around the proper choice of the specific and the generic names. The authoritative specific name was settled eventually by Article 49 *bis* of the rules adopted by the International Botanical Congress of 1910. The choice of generic name is still subject to differences of opinion.

Just what generic name should be adopted depends on breadth of interpretation and on the measure of regard for long established usage.

Three names are involved, namely, *Calyptospora, Pucciniastrum, Thecopsora.* Morphologically, the rusts variously referred to these genera are similar with respect to their aecia and teliospores. This fact has been deemed sufficient by some systematists to warrant the inclusion of all of them under *Pucciniastrum,* a name which has priority over the other two. Another view is held to the effect that a separation of these rusts should be made according to whether their teliospores are subepidermal or intraepidermal. Under that disposition they are distributed between the respective genera *Pucciniastrum* and *Thecopsora.* But many uredinologists prefer to retain *C. Goeppertiana* under the generic name *Calyptospora,* partly because of long established usage, as so frankly admitted by Sydow (20), and partly because *C. Goeppertiana* is characterized by such important distinctive features as more or less aborted, apparently non-functional spermogonia, lack of uredia, cauline teliospores and indeterminate telia which occupy the entire epidermides of "broomed" stems.

Up to this point the synonymy involved centers on what is universally regarded as the same fungus. Quite recently, however, Arthur (2) has added two synonyms concerning which there may be some question of fungus identity, namely, *Peridermium ornamentale* Arthur (in Bull. Torr. Bot. Club, 28: 665. 1901) and *P. Holwayi* Sydow (in Ann. Mycol. 1: 19. 1903). The former was collected Sept. 4, 1900 on Mt. Paddow, Washington at an elevation of about 6000 feet on first year needles of *Abies lasiocarpa.* The latter was described from material collected Aug. 11, 1901 at Glacier, B. C., on second year needles of *A. lasiocarpa.* After careful study of the types, I am convinced that neither is *Calyptospora Goeppertiana,* and that both are probably specifically distinct from each other. Table 1 presents the data on which these conclusions are based.

In this connection it should be noted that the usual practice in herbaria nowadays is to label specimens of these rusts from the western United States and western Canada with the name *Peridermium ornamentale,* regardless of whether the peridermia are on first or second year needles. No recognition is being given to *P. Holwayi* other than to regard it as a synonym. According to the present state of our knowledge, this procedure is without warrant. In short, I tentatively agree with the opinion expressed by Boyce (6) that *P. ornamentale,* as now generally interpreted, "is undoubtedly a composite species, because Peridermia with aecia on the current season's needles and others with aecia on the one-year-old needles are so named."

Just what the diploid phases of *Peridermium ornamentale* and *P.*

TABLE 1

COMPARISON OF CALYPTOSPORA GOEPPERTIANA, PERIDERMIUM ORNAMENTALE AND P. HOLWAYI

	Calyptospora Goeppertiana on *Abies balsamea* (Culture)	*Peridermium ornamentale* on *Abies lasiocarpa* (Type)	*Peridermium Holwayi* on *Abies lasiocarpa* (Type)
Position of spermogonia	Hypophyllous	Amphigenous, but mostly hypophyllous	Amphigenous; abundant on both surfaces
Condition of spermogonia	More or less aborted and apparently not functional	Not aborted and apparently functional	Not aborted and apparently functional
Limits of size of spermogonia	13–30 × 42–137μ	32–54 × 81–175μ	27–54 × 68–138μ
Average size of spermogonia	21 × 73μ	40 × 126μ	35 × 98μ
Occurrence of peridermia	1st year needles Hypophyllous	1st year needles Hypophyllous	2nd year needles Hypophyllous
Seasonal occurrence of peridermia	Early summer of first year	Late summer or early autumn of first year	Summer or late spring of second year
Shape and size of peridermia	Slender, terete	Robust, cylindrical to compressed cylindrical	Robust, compressed cylindrical
Average size of aeciospores	16 × 20μ	14 × 20μ	18 × 23μ

Notes:

(1) Spermogonia of all three are flattened convex, subcuticular.
(2) The occurrence of the spermogonia as hypophyllous or amphigenous might possibly vary according to the host species, just as was found by Faull (10) to be true of *Milesia fructuosa*.
(3) The average size of the spermogonia might possibly vary within fairly wide limits. This could be determined only by the examination of many collections of authentically named specimens.
(4) The robustness and the shape of the peridermia might possibly vary according to the host species or according to nutritional and environmental factors.
(5) Whether or not a rust might form its peridermia in the latter part of the first year or the early part of the second year, depending on seasonal or other factors, is unknown. But so far this has never been demonstrated for any species. If it be true of *P. ornamentale* or *P. Holwayi*, then one important reason would be removed for regarding them as distinct species.

Holwayi may be, remains for cultural determination. Their characteristics, however, indicate a Pucciniastrum relationship. Such, too, is Boyce's view (5), although his surmise, based on field associations of the rusts, that *Pucciniastrum Myrtilli* on *Vaccinium* is the diploid phase of *Peridermium ornamentale* is quite improbable. *Pucciniastrum Myrtilli* is known to have *Tsuga* as its alternate host, and all attempts so far to culture it on *Abies* have failed. If *Peridermium ornamentale* does infect *Vaccinium,* then the resulting diploid phase might resemble that of *Pucciniastrum Myrtilli;* but with at least equal likelihood it might resemble that of *Calyptospora Goeppertiana.* The same applies to *Peridermium Holwayi.* That there may be a second species of *Calyptospora,* as yet unnamed, in western North America has already been suggested by Weir (21) in his comparative study of what he took to be *Calyptospora Goeppertiana.* His conclusion was influenced solely by differences in the shape and the robustness of the peridermia characteristic of *C. Goeppertiana* and *P. ornamentale.* He expressed himself as follows — "It is here proposed to reverse an earlier view on the identity of the aecial form on *Abies* with large cylindrical or flattened peridia and suggest the probability of there being another species of *Calyptospora* with telia on *Vaccinium.* This suggestion is based purely on field observations. All collections of the large aecial form so far made by the writer have been in close association with the typically appearing telial stage on *Vaccinium.* Wherever the large aecial form has been collected the form with small cylindrical peridia has been absent, with the reverse as true." He adds, — "Another view," apparently not his own, "would be that the size of the aecia is influenced by the vigor of the host and that the two forms are identical." Incidentally it should be remarked that if there be a second species of *Calyptospora* on *Vaccinium* in western North America, then the collections labelled *C. Goeppertiana* from that part of the world are subject to revision.

Here, then, is a simple, well defined problem in western North America that can be solved by making suitable cultures — the problem of adequately defining the rusts included under the names *Calyptospora Goeppertiana, Peridermium ornamentale* and *Peridermium Holwayi.*

LIFE HISTORY STUDIES

Several successful life history studies have been made of *Calyptospora Goeppertiana.* Robert Hartig (13, 14) cultured it from *Vaccinium Vitis-idaea* on *Abies alba,* and then in the reverse direction. He made no mention of spermogonia. Kühn (16, 17, 18) then cultured it from *V. Vitis-idaea* on *Abies alba, A. balsamea, A. cephalonica, A. cilicica,*

A. concolor, A. Fraseri, A. magnifica, A. nobilis, A. Nordmanniana, A. Pinsapo, A. sibirica and *A. Veitchii*. He also made no mention of spermogonia. Bubák (7, 8) cultured it from *V. Vitis-idaea* on *A. alba*. No spermogonia were recognized. Arthur (1) cultured it from *V. pennsylvanicum* on *A. Fraseri*. He remarked, "pycnia rarely if ever found." Fraser (11, 12) cultured it from *V. pennsylvanicum* on *A. balsamea*. No spermogonia were recognized. He also inoculated *Tsuga canadensis* with telial material, but the results were negative. Weir (21)* cultured a rust, which he took to be *C. Goeppertiana*, from *A. lasiocarpa* on *V. membranaceum*. In other experiments he cultured the rust from brooms of *V. membranaceum* on *A. lasiocarpa*, and also carried it forward from *Vaccinium* to *Vaccinium* by making infected tissue plantings. Finally, I have made many cultures on *A. balsamea*, using as inoculum telial material from *V. pennsylvanicum* and *V. canadense*. Summaries of my experiments are recorded in Tables 2 and 3 of this paper.

TABLE 2

CULTURES OF CALYPTOSPORA GOEPPERTIANA
FROM VACCINIUM PENNSYLVANICUM TO ABIES BALSAMEA

1. *Forty-five inoculation experiments* were made; all gave *positive* results.
2. The dates of inoculation ranged from June 8 to June 20.
3. Yellowing of the needles appeared 12 to 17 days after inoculation. *The average was 14 days.*
4. Spermogonia were first observed 13 to 19 days after inoculation. *The average was 16 days.*
5. The peridermia were first observed 17 to 24 days after inoculation. *The average was 21 days.*
6. The peridermia began to rupture one to five days following their first appearance.
7. The production of peridermia was practically completed within 32 days after inoculation. *The average was about 29 days.*

*Through the courtesy of the United States Bureau of Plant Industry I have had the opportunity of examining an unused part of Weir's aecial inoculum from *Abies lasiocarpa*, and also meager infections on *A. lasiocarpa* that resulted from his inoculations with telial material of *Vaccinium membranaceum* origin. I would be hesitant, however, to unreservedly pronounce either as *Calyptospora Goeppertiana*. Spermogonia do occur on both of them, though with comparative scantiness. No distinctly aborted spermogonia were found; but I could not determine whether or not spermatia were produced. Certainly the peridermia are more robust than those characteristic of *C. Goeppertiana* on *Abies balsamea* and not less so than some of *Peridermium ornamentale*. Moreover, the first material referred to above was collected after the middle of September, which suggests a long developmental period as compared with the few weeks required for the development of *C. Goeppertiana* on *A. balsamea*.

8. The number of infected needles with peridermia varied from 6 to 203. *The average was 70.*
9. The number of peridermia per needle varied from 22 to 41. *The average was 27.*
10. J. H. Faull Herbarium nos. 7269–7279, 7403 and 8116–8132.

TABLE 3

CULTURES OF CALYPTOSPORA GOEPPERTIANA FROM VACCINIUM CANADENSE TO ABIES BALSAMEA

1. *Three inoculation experiments* were made; all gave *positive* results.
2. The date of inoculation was June 22.
3. Yellowing of the needles appeared 11 to 13 days after inoculation. *The average was 12 days.*
4. The spermogonia were first observed 13 to 15 days after inoculation. *The average was 14 days.*
5. The peridermia were first observed 21 days after inoculation.
6. The peridermia began to rupture two days following their first appearance.
7. The production of peridermia was practically completed within 25 days after inoculation.
8. The number of infected needles with peridermia varied from 75 to 108. *The average was 90.*
9. The number of peridermia per needle varied from 27 to 41. *The average was 33.*
10. J. H. Faull Herbarium nos. 8133–8135.

HOSTS

The haploid phase of *Calyptospora Goeppertiana* has been shown by cultures to have as hosts the following species of *Abies* — 1. *Abies alba* Mill. 2. *A. balsamea* (L.) Mill. 3. *A. cephalonica* Loud. 4. *A. cilicica* Carr. 5. *A. concolor* Lindl. & Gord. 6. *A. Fraseri* (Pursh) Lindl. 7. *A. lasiocarpa* Nutt. 8. *A. magnifica* A. Murr. 9. *A. nobilis* Lindl. 10. *A. Nordmanniana* Spach. 11. *A. Pinsapo* Boiss. 12. *A. sibirica* Ledeb. 13. *A. Veitchii* Lindl. Other species of *Abies* have been recorded as hosts but they have not been confirmed by cultures. It would seem probable, however, from this list that most, if not all, species of *Abies* are susceptible to *C. Goeppertiana.*

The diploid phase of *C. Goeppertiana* occurs on the following species of *Vaccinium* — 1. *Vaccinium canadense* Kalm. 2. *V. corymbosum* L. 3. *V. Myrtillus* L. 4. *V. pennsylvanicum* Lam. 5. *V. vacillans* Kalm. 6. *V. Vitis-idaea* L. 7. *V. Vitis-idaea* var. *minus* Lodd.

Many species from western North America are also recorded as hosts of *C. Goeppertiana*. But, for reasons already expressed, the determinations may be subject to revision. Nevertheless it is probable that they, too, may serve as hosts for this rust. The list is as follows — *Vaccinium caespitosum* Michx., *V. Chandleri* Jepson, *V. erythrococcum* Rydb., *V. membranaceum* Dougl., *V. microphyllum* Rydb., *V. oreophilum* Rydb., *V. ovalifolium* Sm., *V. ovatum* Pursh, *V. parvifolium* Sm., *V. scoparium* Leib.

SPECIMENS EXAMINED

O and I. On *Abies alba*.

GERMANY: München, July 1910, J. H. Faull.

O and I. On *Abies balsamea*.

NOVA SCOTIA: Card Lake, July 21, 1929, J. H. Faull. — Mahone, July 22, 1929, J. H. Faull. — Liscomb Park, July 30, 1929, J. H. Faull.

ONTARIO: Timagami, July 4, 16, 25, 1919, J. H. Faull. — Timagami, July 10–16, 1924; CULTURES from *Vaccinium pennsylvanicum* by J. H. Faull and W. G. Watson. — Timagami, July 11, 1925; CULTURES from *V. pennsylvanicum* by E. H. Moss. — Timagami, July 16–19, 1926; CULTURES from *V. pennsylvanicum* by J. H. Faull and G. D. Darker. — Timagami, July 17–18, 1926; CULTURES from *V. canadense* by J. H. Faull and G. D. Darker. — Timagami, July 12, 1927, G. D. Darker 2041.

III. On *Vaccinium canadense*.

MAINE: Eustis, Oct. 23, 1931, J. H. Faull.

ONTARIO: Timagami, Aug. 19, 1921, J. H. Faull. — Timagami, May 12, 1924, J. H. Faull.

QUEBEC: Mt. Albert, Gaspé Co., Aug. 21, 1933, J. H. Faull.

III. On *Vaccinium pennsylvanicum*.

MAINE: Eustis, Oct. 23, 1931, J. H. Faull. — Solon, Aug. 27, 1935, J. H. Faull.

NEW HAMPSHIRE: Mt. Jefferson, Aug. 31, 1932, J. H. Faull.

NOVA SCOTIA: Card Lake, July 21, 1929, J. H. Faull. — Liscomb Park, July 30, 1929, J. H. Faull.

ONTARIO: Timagami, July 5, 16, 29, 1919, J. H. Faull. — Timagami, June 18, 1923, J. H. Faull. — Timagami, July 8, 1924, J. H. Faull. — Timagami, May 31, 1925, J. H. Faull.

III. On *Vaccinium Vitis-idaea*.

ALBERTA: Mercoal, Aug. 8, 1925, W. R. Watson.

JAPAN: Mt. Oakan, Prov. Kushiro, Aug. 21, 1926, N. Hiratsuka 546.

III. On *Vaccinium Vitis-idaea* var. *minus*.

NEW HAMPSHIRE: Mt. Jefferson, Aug. 31, 1932, J. H. Faull.

SUMMARY

1. A review of the literature indicates that thirteen species of *Abies* have been proved by experiments to be susceptible to *Calyptospora Goeppertiana* Kühn. None are known to be immune.

Likewise, many species of *Vaccinium* have been recorded as hosts of *C. Goeppertiana.* A few of them have been used in making life history studies of the rust, namely, *V. Vitis-idaea, V. pennsylvanicum* and possibly *V. membranaceum* by previous investigators, and *V. pennsylvanicum* and *V. canadense* by the writer.

2. Life history studies made by the writer are summarized in Tables 2 and 3 of this paper. In these, *C. Goeppertiana* was successfully passed from *Vaccinium pennsylvanicum* and *V. canadense* to *Abies balsamea.*

3. *Peridermium ornamentale* Arthur and *P. Holwayi* Sydow, more recently held to be synonymous with *C. Goeppertiana* Kühn, are compared (Table 1) with one another and with the haploid phase of *C. Goeppertiana.* The disagreements noted lead to the conclusion that they are probably distinct forms and that neither is *C. Goeppertiana.* The diploid phases of *P. ornamentale* and *P. Holwayi,* interpreting these forms from their type specimens, have not yet been demonstrated.

4. So far, one species only of *Calyptospora* has been described. If, however, *P. ornamentale* and *P. Holwayi* should prove to be as yet unnamed species of *Calyptospora,* then the identification of collections from western North America, now passing under the name *C. Goeppertiana,* is subject to revision. The answer awaits culture experimentation.

5. The record of specimens studied in connection with the preparation of this paper extends our knowledge of the geographical distribution of *C. Goeppertiana* and gives recognition to *V. Vitis-idaea* var. *minus* Lodd. as a host of that rust.

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THYRONECTRIA DENIGRATA (WINTER) SEAVER, THE CAUSE OF DISEASE IN GLEDITSIA

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TWO HERETOFORE UNDESCRIBED DISEASES of *Gleditsia* have been studied by the writer during the past three years. One is a wilt of *G. japonica* Miq. and the other a canker of *G. triacanthos* L. The former is certainly caused by *Thyronectria denigrata* (Winter) Seaver (*Pleonectria denigrata* Winter), a fungus so far recognized as a saprophyte only, and the latter seems to be caused by the same fungus. The wilt disease was observed in the Arnold Arboretum, and the canker on Nantucket Island, Massachusetts.

Gleditsia japonica is represented in the Arnold Arboretum by a few trees raised from seed of Korean origin, received in 1904. These trees grew well. But in May 1933 one of them suddenly wilted and died. A second one died similarly in October 1937 and a third in August 1938. The symptoms throughout resemble those of the Dutch Elm Disease both as to wilting of the foliage and discoloration of the wood. The discoloration is of a red-orange color (Bittersweet Orange darkening on air exposure to Grenadine Red, Ridgway).

Cultures from the stained areas in all cases developed the same fungus. On potato-dextrose agar this appears first as a low mat of fine white mycelium which later produces from simple conidiophores many small, single-celled, oval, hyaline spores. Soon parts of the agar surface become covered with a wettish orange-colored mass of spores and these bud much in the manner of yeasts. This phase might be classified as a *Sporotrichum*. As the cultures dry out, provided they are exposed to light, the mycelium balls up to form white, felted, botryoidal pycnidia with black top-surfaces which crack and exude orange-colored cirri of spores of the same size and shape as spores newly borne on the earlier hyaline conidiophores. Cultures kept in the dark do not show pycnidia and the color of the mycelium appears yellower.

Logs cut from the diseased trees showed after a few weeks pycnidia with cirri of orange spores but produced on stromata which protruded through the lenticels. Spores from these grew in culture exactly as did the isolations from discolored wood. The stromata and pycnidia and

cultural characteristics are identical in every way with those of stages of *T. denigrata* from *G. triacanthos.*

Numerous attempts to produce ascospores in culture have not been successful. Single ascospore cultures of *T. denigrata* have been made, however, and all details of growth of the fungus up to the production of pycnidia on large stromata have been found exactly similar in fungi from both sources. Moreover, immature perithecia like those of *Thyronectria* have been found on overwintered branches of the diseased *G. japonica.* Experimental proof was obtained by inoculating 30 seedlings of *G. japonica.* Forty per cent of the seedlings became infected and soon died. *Thyronectria denigrata* was readily isolated from the discolored wood and no other fungus was present. From the facts that the trees in question died suddenly, that discoloration and hyphal threads were found throughout the same annual ring of the trunk and branches, and that they were limited to the vessels, it is deduced that once infection starts the fungus is a very active parasite in *G. japonica.* Small conidia seen in the vessels no doubt hasten the spread of mycelium in the tree.

In the literature *T. denigrata,* though often collected on American gleditsias, has not been suspected of being a parasite. However, the author has observed many trees of *G. triacanthos* on Nantucket Island where some signs of parasitism following severe winters were apparent. In some instances fatalities resulted. Cankers were the conspicuous symptoms and no wilting was observed. In these trees at the border of infected wood was a red-orange line of demarcation localized to the canker, and not widespread as in *G. japonica.* Cultures indicated that *T. denigrata* was the causal organism.

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THE VEGETATIVE PROPAGATION OF DIFFICULT PLANTS

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With plates 228–231

INTRODUCTION

PROPAGATORS and gardeners have long been familiar with the fact that certain plants are readily propagated from cuttings, while others are not. The latter, which may be termed "difficult" or "resistant" plants, belong to many taxonomic orders, and there is no reason to associate their failure to form roots with any anatomical peculiarities. The discovery of the rôle of hormones in root initiation and the identification of the auxins as the substances primarily concerned (for literature see Went and Thimann, 1937) led of course to the supposition that failure to root was due to an insufficient supply of auxin. Hence the application of auxin to cuttings of such plants should induce root formation. In part this expectation was justified. Application of auxin in suitable concentration both hastens root development and increases the numbers of roots formed, on most plants which are capable of rooting at all. The list of plants for which data on the promotion of root formation by auxin treatment have been given is now very large (Chadwick, 1937; Cooper, 1935, 1938; Gočolašvili and Maximov, 1937; Hitchcock and Zimmerman, 1936; Laibach and Fischnich, 1935; Müller, 1935; Poesch, 1938; Pearse and Garner, 1937; Pearse, 1938; Traub, 1938; Went, 1934).

Nevertheless, it was soon found that many of the most resistant plants, which ordinarily are never propagated by cuttings, are not even induced to form roots by auxin treatment. So far as trees are concerned, these plants comprise three main groups: — (1) a majority of the conifers, (2) many forest hardwoods, (3) the apples and related rosaceous trees. There are a number of others. Evidently failure of these cuttings to root is not primarily due to insufficient auxin supply, and this is *a priori* reasonable, because we know that auxin is universally present at least in the spring and during the period of growth, so that if auxin supply were the controlling factor cuttings of "difficult" plants should at least root when taken at this time of year.

We have therefore considered it of importance to make a general

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study of the rooting of "difficult" plants, particularly since our present knowledge of auxin relations, and the unlimited availability of pure synthetic auxins, make it possible to control this one factor adequately. The study was made more urgent because the work of the Maria Moors Cabot Foundation involves the selection and breeding of conifers and forest trees, many of which fall into groups (1) and (2) of the above classification of "difficult" plants.

Much of our work has centered upon white pine (*Pinus Strobus*) but the principles brought to light have in each case been tested on other conifers and hardwoods. Data on the third group of trees will not be included in this first report.

Occasional reports of the rooting of cuttings of white pine and other *Pinus* species have appeared in the literature (see, for instance, Mirov, 1938, and literature there cited). Such reports are of little use for our purposes, however, firstly because quantitative data on the percentage of cuttings which rooted are rarely, if ever, given, and secondly because the exact conditions which brought about rooting on the particular occasion reported, as opposed to the numerous and widespread failures, are not investigated. In order to be of use for selection work, rooting must be under control and must be at least partially quantitative. As far as possible, therefore, we have attempted to define our conditions and to report all data quantitatively. Repetition of the experiments elsewhere should involve no difficulty.

In the course of the work a few trees have been found which are in fact readily rooted by auxin treatment alone. The most notable of these is the Canadian hemlock (*Tsuga canadensis*). *Picea pungens* behaves similarly. Successful rooting of white pine and others involves, however, other considerations.

The factors mainly studied have been:—

(1) The age of the tree from which cuttings are taken. This is by far the most important single factor.

(2) Optimal auxin treatment.

(3) The relative rooting behavior of different parts of the plant.

(4) Rooting medium and temperature, including treatment of the bases of the cuttings with hot water or permanganate.

(5) Factors other than auxin, namely, sugar and vitamin B_1.

MATERIAL AND METHODS

All cuttings unless otherwise specified were of wood in its first year of growth, i.e. from 4 months up to one year old, or "one-year wood."

Cuttings of *Pinus Strobus, Tsuga canadensis* and its variety *pendula, Taxus baccata* and its variety *repandens, Picea Abies* and *Picea pungens* were obtained from trees of known age at the Arnold Arboretum. Those from young trees were obtained in part from the Harvard Forest Nursery (courtesy of Dr. Paul R. Gast) and in one case from a commercial grower. Cuttings of *Keteleeria Davidiana* Beiss. were from a tree about 10 years old at Cambridge. All were taken at the base of the one-year growth.

Hardwoods. Cuttings of *Fraxinus americana* were obtained from trees of known age at the Arnold Arboretum. Young trees of *Acer platanoides* as well as cuttings from old trees of *Populus nigra* var. *italica* and *Populus grandidentata* were collected in the vicinity of Cambridge. Young trees of *Quercus borealis* were obtained commercially. As far as possible all were taken with a "heel" at the base of the one-year wood.

Treatment. The cuttings were placed with their bases immersed 1–2 cm. deep in the auxin solution or water at room temperature for 24 hours, rinsed and placed in propagating boxes. Unless otherwise stated, the auxin used was indole-3-acetic acid (Eastman or Hofmann-La Roche). Sugar and other treatments are described below. The boxes were of cypress, fitted with a hinged glass cover which was generally kept nearly closed. During the summer the boxes were covered with two thicknesses of cheesecloth to reduce the light. The boxes were kept in the greenhouse with a minimum winter temperature of 60°F (15°C). The bottom was covered with coarse gravel to a depth of one inch, then by about 5 inches of sand, sand-peat mixture or pure peat. The mixture was found the most practical on the whole. Bottom heat, where used, was supplied by means of a G. E. unit no. 69×787. The medium was kept as moist as possible consistent with good aëration.

The experiments were carried out, in most cases, by dividing a group of several hundred cuttings into smaller groups each of which received a different treatment. For example, 300 cuttings might be divided into 4 groups of 75 for different auxin concentrations, and each of these subdivided into 3 groups of 25 to compare peat, sand and peat-sand mixture as rooting medium. Though the final number in any one group was thus small, the effect of any treatment can be determined from quite a large number of cuttings by adding together all those receiving that treatment in the different groups. This procedure, which must, of course, be applied with discretion, allows the effects of a number of variables to be surveyed. The important points can then be checked by separate experiments.

Since some 50,000 cuttings have been studied in small groups in this way it will not be possible to give the whole of the data in undigested form, but the principal conclusions and the evidence for them will be presented.

RESULTS

1. The age of the plant

A large number of experiments with both soft and hard wood cuttings of *Pinus Strobus* (white pine) and *Quercus borealis* (red oak) taken from mature trees at different times of the year, treated with various concentrations of auxin up to 400 mg. per liter and kept in different rooting media, showed that in no case was there an appreciable percentage of rooting. The cuttings often survived for months, sometimes with development of buds or leaves, but eventually withered. It was not until attention was turned to cuttings from young trees that satisfactory rooting was attained.

It was then found that cuttings of white pine taken from trees two or three years old rooted rather quickly even without auxin treatment. With auxin the rooting was somewhat hastened and the percentage of cuttings rooting greatly increased. The results of a number of experiments on cuttings from trees of different ages are summarized in table 1.

It is clear that the percentage of rooting in water controls decreases steadily with increasing age. Cuttings from the older trees will not root appreciably whether treated with auxin or not. The rooting reported by Mirov (1938) from ten-year old trees must have either been in extremely low percentage*, or else his conditions were in some way more favorable than ours. Cuttings from the very young plants root readily. There is an intermediate age of about 3 years in which water controls root sparingly, but the percentage may be raised to 50 (or in occasional cases to 75 or 100) by treating with auxin. As will be shown in section 2, the optimum concentration of indole-acetic acid for 24-hour treatment of such young pines is usually 200 mg. per liter.

Plate 228, figure 1 shows the appearance of some of the cuttings. The roots are thick, few in number and grow laterally. All groups showed very high percentage of survival and gave excellent growth. In one case a short shoot, i.e. single fascicle of needles, from a 3-year old tree formed roots and started to develop a terminal bud.

This effect of age is evidently widespread. It is shown markedly by spruce, maple and oak and also probably by ash. Table 2 summarizes experiments with one species of each of these and Plate 228, figure 2

*No numerical data are given in his publication.

shows a sample of the *Picea Abies* cuttings. It is notable that with the 6-months old maples auxin actually reduced the rooting, probably because the concentration (100 mg. per liter) was too high for such young material (cf. the youngest pines in table 1). A number of other experiments with maple have been lost through infection. On the whole the maples so far studied have shown little increase in rooting from auxin treatment. In all the species shown in table 2, as well as with *Aesculus* and *Ginkgo,* with which a few trials have been made, rooting is far more prevalent when cuttings are taken from young than from old trees.

2. Optimal auxin treatment

In order to minimize variables, all cuttings have been treated at the base with aqueous solutions of auxin for 24 hours at room temperature. Sufficient leaf surface was always present to allow of reasonable transpiration. Where leaves were to be cut back this was never done before the auxin treatment. For each plant a series of concentrations was tested, using this one exposure time and treating all cuttings the same way. Controls were placed in water for the same period.

As mentioned above, some conifers were found to root readily even on cuttings taken from old trees (70 years or more). Results from six such species are given in table 3. The most striking result is the readiness of rooting of hemlock (*Tsuga canadensis*) on treatment with auxin, when untreated cuttings in no case formed a single root (see Plate 229, figure 1). Hemlock, at least when cuttings are taken in the fall, is thus a good example of a plant adequately supplied with all factors for rooting except auxin.

The extreme slowness of rooting on the whole, especially in the yews, is also remarkable. In both yew species, however, roots appeared earlier on auxin-treated cuttings than on the controls.

It is impossible to make any general deduction about optimal auxin concentration. Each species apparently has its own optimum. In many, auxin 400 mg. per liter is highly toxic and results in killing of the tissue from the base up to the level reached by the solution. While this may lead to decreased rooting it does not always do so. Thus the *Taxus baccata* cuttings in table 3 were killed up to 2 cm. or so above the base, but they nevertheless rooted vigorously above the killed zone. Good rooting above the killed zone is also shown by other species, notably *Tsuga* (Plate 229, figure 2) and *Picea* (Plate 229, figure 3). This fact may be of theoretical importance (see discussion). Another difficulty arises from the fact that the concentration actually optimum for root-formation may not be optimal in practice, because cuttings exposed to

the higher concentrations frequently show extreme inhibition of the buds. Thus although the blue spruce (*P. pungens*) rooted freely in auxin, bud development was practically prevented for some months in all but a few specimens. In *Populus,* also very marked bud inhibition was shown on cuttings treated with 100 mg. per liter.

The variability of the "optimum" is further shown in respect to root number. As is well known, cuttings of aspen (*Populus tremuloides*) and Lombardy poplar (*P. nigra* var. *italica*) root readily. Plate 230, figure 1 shows the numbers of roots produced in 3 weeks. All cuttings, including water controls, produced one or more roots in this time. The reduction in root number at high concentrations is of course due to killing of the basal tissue, which was preceded by much swelling and splitting of the bark caused by vigorous cell enlargement in the cortex. The interesting point of Plate 230, figure 1 is that while *P. nigra* var. *italica* shows a reduction in root number at 100 mg. per liter, *P. tremuloides* shows a very large increase at this concentration. Both sets of cuttings were of the same age, taken at about the same time of year, and treated identically.

The corresponding data for young trees of some of the more difficult species are shown in table 4. Points worth noting are: — (a) the high percentage rooting of the young spruces treated with relatively weak auxin; (b) the high percentage reached by the young oaks in 400 mg. per liter; these were basal parts of the trees, the wood being 2 to 3 years old, and showed little or no killing by this high concentration (see section 3); (c) the failure of maple cuttings to respond notably to auxin treatment; (d) the rather extensive rooting of the white pines, 3 years old.

These data confirm and extend those of table 1; the second set of 3-year pines in table 1 is in fact the mean of the separated figures for lateral and terminal shoots in table 4. The others listed are from separate large experiments. The overall percentage rooting in these large groups does not much exceed 50%, but in individual smaller groups it is often greater (see table 6).

Again these data do not allow of any statement as to the optimal auxin concentration. Taking all of our experiments on white pine together, however, the optimum is 200 mg. per liter. The statement of Went and Thimann (1937) that "the highest non-toxic concentration of indoleacetic acid, dissolved in water, will give the best results" remains as near the truth as any.

Other methods of applying auxin, as in lanoline paste or in fine dust with talc, are also under test on cuttings of these types and may be reported on later.

It has recently been reported by Cooper and Went (1938) that a second auxin treatment some time after the first may give good results. Our own experiments on such "retreatment" are not very numerous. In one experiement 3-year old white pine (taken in March) treated 24 hours with 100 mg. per liter auxin gave only 4% rooting; when the treatment was repeated 3 days later the final rooting was 9%. On another occasion the same concentration produced 15% rooting on 3-year old and 15% rooting on 4-year old white pine; when retreated 3 days later the final values were 25% and 18% respectively. Thus in each case there was a small increase in the percentage rooting. The time for rooting was about 10 weeks in each case. Continually repeated treatments, though inconvenient in practice, might perhaps be more effective.

From time to time statements have been made that indole-butyric or α-naphthalene-acetic acids are more effective for root-formation than indole-acetic. Such comparisons as we have made do not bear this out. The differences are not large and are usually in favor of indole-acetic acid. *Syringa vulgaris* (var. "de Louvain,") taken in April, treated with 50 mg. per liter of each auxin, gave after 5 weeks 14% rooting with indole-acetic, 3% with α-naphthalene-acetic and 0% and 8% in two experiments with indole-butyric. Similarly Concord grapes (cuttings of one-year wood taken in May) gave 87% in indole-acetic and 73% in indole-butyric acid; the average number of roots formed was 11.1 with indole-acetic and 7.6 with indole-butyric acid. The water controls gave 60% rooting with an average root number of 1.4. It is possible that the contrary statements reported elsewhere are due to the use of impure samples of the substances.

Another statement occasionally made is that the salts of the auxins are more effective than the free acids. In so far as growth promotion is concerned this has been disproved by D. Bonner (1937) and Thimann and Schneider (1938). However, the data of the latter authors showed that, at very high concentrations, the toxicity or damage effect was reduced by neutralizing the acids to form salts. Since such high concentrations are just those used in propagation, a comparison was made between the free acid and the salt with indole-acetic, using cuttings from 3-year old white pine (table 5). Each figure in the table is based on 50 to 70 cuttings. The differences are insignificant.

3. The relative rooting ability of different parts of the plant

As shown in table 4, the lateral branches of *Pinus* consistently root better than the terminal shoots. The mortality among the lateral cut-

tings is also less. Table 6 shows in more detail the percentage rooting in water and in optimal auxin (either 100 or 200 mg. per liter indoleacetic acid) for 5 groups of lateral and terminal cuttings. Each figure is the average of 20 to 60 cuttings. In all groups but one the laterals give the higher rooting percentage in water controls, and in all 5 groups the higher percentage in auxin, 100% being reached in one case. The mortality among water controls is also significant. After a month 32% of all terminals treated with water had died, but only 3% of all laterals. Other experiments gave comparable results. One group of pine cuttings, taken in July, which rooted very poorly, gave only 0.4% rooting in terminals, as compared with 7.9% in laterals. Norway spruce (also included in table 6) shows the same phenomenon. The average behavior of a still larger number of cuttings from 3-year old white pines and Norway spruces is summarised in Plate 230, figure 2.

In view of the occasional records of rooting by layering of lateral branches under natural conditions it is possible that the ability of laterals to form roots (of course only to a very small extent, and not in *Pinus* itself) persists up to a considerable age.

It is interesting to note that the plagiotropic habit of growth is retained in lateral branches of *Picea* after they have rooted. As Plate 230, figure 3 shows, the new growth which develops after rooting is always at an angle to the vertical, while that of terminal shoots is erect. Of a total of 53 rooted laterals which were potted for observation, every one grew at an angle in this way, while all of the 18 rooted terminals which were potted grew vertically. This appears to be in conflict with observations such as those of Errera (1905) that when *Picea Abies* is decapitated one of the laterals grows vertically, for in that case the influence of the tip would only have to cease in order for the lateral growth to be changed. Our observations show that whatever influence has caused the plagiotropism of these laterals is by no means lost when they are isolated from the tree. It may, of course, be that in subsequent years these cuttings (which have been planted out) will change their habit. In *Pinus* this phenomenon is not shown, and rooted laterals seem to grow just as vertically as the terminals (Plate 231, figure 1).

Another difference in the rooting of different parts was found with oak and maple. Here, in young trees, the lateral shoots are short and not very vigorous. The apical part of the plant, comprising the last year's growth, roots rather poorly, and its rooting is not promoted appreciably by auxin treatment. The basal part, on the other hand, roots well and responds strongly to auxin. As table 7 shows, the bases of *Quercus borealis* can withstand 400 mg. auxin per liter and give very high per-

centage rooting therein; even in water controls there is moderate rooting. Some of the rooted cuttings are shown in Plate 231, figure 2. The data for *Acer* show the same effect. Here the numbers in each auxin group were too small for significant results, so that only the combined results are given. The reason for this behavior is not yet known (see discussion), but its practical importance for propagation when young trees are used is evident. The difference between apex and base has not yet been studied in conifers.

4. Medium and temperature conditions

A few comparisons of different rooting media are shown in table 8. On the whole either peat or the 2:1 mixture of sand and peat give slightly higher percentages of rooting than sand alone. On account of its high water content pure peat is apt to become very cold, and unless bottom heat is used this is a drawback. There was also (in *Pinus*) a higher percentage of rotting when the rooted cuttings were left in the peat than in the other two media. Since the differences are in no case large the mixture was mainly used.

The use of bottom heat for *Pinus* cuttings is definitely undesirable. Rooting was slower and of lower percentage in heated than in unheated boxes. The unheated boxes had a mean winter temperature close to 18°, the heated were maintained at 24°. In both cases somewhat higher temperatures (up to 27°) were reached in summer, even though the boxes were kept covered with cloth. Comparisons were not made on cuttings other than pine, since in many cases a temperature around 24° is known to be advantageous.

Treating the cuttings with permanganate (cf. Curtis, 1918) is also undesirable where auxin is to be applied basally. In our experiments the bases of the cuttings after placing in 0.1% $KMnO_4$ were thoroughly rinsed, but the data indicate that traces may have remained sufficient to inactivate part of the auxin afterwards applied. Indole-acetic and butyric acids are very sensitive to oxidation. The results for the two conifers in table 9 show only a reduction in rooting by permanganate treatment. In other experiments white pine also showed a small reduction. With poplar the effect of the treatment on the number of roots was studied, but though there was a slight increase in root number on the controls, the response to the auxin was decreased (table 9). It is notable, however, that those exposed to the highest auxin concentration were partially protected from killing by the permanganate. This may be due to partial auxin inactivation or perhaps to plugging of the vessels by the precipitate of manganese hydroxide and hence reduction in the

amount of auxin taken up. When auxin is applied at the apex, as in the standard pea-rooting test (Went, 1934; Thimann and Went, 1934) or with lanoline (Laibach, 1933, Laibach and Fischnich, 1935), permanganate inactivation of auxin probably does not occur because the auxin is already within the cells when it reaches the base.

Another frequently used procedure for pines and other resinous plants is to soak the bases of the cuttings in hot water to remove the resin. In a series of comparisons in which cuttings from 3-year old white pine were immersed in hot water at from 40° to as high as 90° for times between 2 minutes and 2 hours no beneficial effect was observed. The percentage was never above, and sometimes below, that of cold water-treated controls. Thus in one set of experiments the mean of all auxin concentrations for hot water treated cuttings was 14%, that of cold water-treated controls 17%. In another set the values were 15% and 24% respectively. In view of the fact that resin was certainly exuded from the bases of the cuttings, there seems no reason to believe that this in itself has any inhibitory effect on rooting. Usually the resin came away readily enough on wiping or on placing in the propagating boxes. Hot water treatment has not been tested on other conifers.

5. Substances other than auxin

The action of auxin is to cause the initiation of roots. The root initials thus formed must then grow out, and this growth requires nutritive materials. Probably carbohydrate is the most important single factor for such growth. In experiments with etiolated plants, rooting is definitely dependent on the supply of sugar (Bouillenne and Went, 1933; see Went and Thimann, page 194, figure 62). Plants in the light, with leaves, might be expected to have an adequate carbohydrate supply, but our experiments show that this is not necessarily true. Table 10 gives representative data from ash and white pine cuttings, which were immersed in the auxin solution (or in water) for 24 hours as usual and then placed in 5% sucrose for 3 days, rinsed and transferred to the propagating boxes. All figures except the last pair represent percentage rooting. The last pair of figures shows that the mortality among the cuttings is reduced by sugar treatment. This effect became marked early in the experiment, most of the non-sugar cuttings which had not rooted dying off within 6 weeks, while in the sugar-treated cuttings a large proportion of the unrooted cuttings still lived. When it is remembered that one of the major problems of propagation is maintenance of the unrooted cuttings, the value of such sugar treatment is clear. The increase in percentage rooting may be due, at least in part,

to this action of sugar on maintenance. The young ash cuttings in table 10 gave poor rooting and the data are not significant.

Another substance known to be essential for growth of roots is vitamin B_1 or aneurin. Went, Bonner and Warner (1938) have increased the rooting of camellias and other plants considerably by treatment with this substance. The effect is presumably not exerted on root initiation itself but only on subsequent growth of the roots. Our own experiments on vitamin B_1, while not very numerous, have not shown very marked effects. When it was first found that cuttings from old pines did not root after treatment with auxin, the action of vitamin B_1 was tested. Of a large group of cuttings taken in September from a tree 65 years old, a number were treated for 24 hours with 1 mg. per liter of vitamin B_1 following auxin treatment, but none rooted. In another group the cuttings were given the same concentration of vitamin B_1 two months after auxin treatment, and also given sugar. One of the cuttings later rooted. With *Fraxinus*, a group of cuttings which had not rooted one month after auxin treatment were given the vitamin, and 7 weeks later 10% had rooted, while the control group not given the vitamin but having received the same auxin treatment gave no rooting. Another group of *Fraxinus* which were given sugar as well as auxin gave 2% rooting when receiving no vitamin and 5% when given 1 mg. per liter for 24 hours one month after the auxin treatment.

The results are thus favorable to the vitamin treatment, though the effects are small, and it may be deduced that, as with carbohydrate, the amount of vitamin B_1 present or synthesized in the cutting is probably not optimal. However, it is also evident that neither the vitamin nor carbohydrate is the factor which is missing from old trees.

A few experiments have also been made with a biotin preparation (from egg yolk), biotin being also known to be of importance in rooting (see Went and Thimann, page 196). The data are insufficient for report here, but it is of interest that one cutting from old pines rooted when the auxin treatment was followed by biotin.

More systematic trials with these substances are of course in progress.

DISCUSSION

Without doubt the main fact of importance which the experiments have shown is that the tendency to form roots is controlled not by the age of the cutting, but by the age of the tree from which the cutting is taken. This is, of course, in some ways an old observation, since as long ago as 1913 Goebel pointed out that cypress cuttings taken from juvenile plants root more readily than those from mature trees. The

literature contains several scattered reports of the same type, and one very important systematic study by Gardner (1929). Of 21 trees studied, including seven conifers, all but two species showed very much better rooting when cuttings were taken from one-year seedlings than from old trees. Where two- and three-year old trees were studied the percentage rooting decreased with increasing age. The recent study of Stoutemyer (1937) confirms the findings of Gardner in that the tops of one-year apple seedlings seldom failed to root. Stoutemyer further shows that ease of rooting in these young plants is associated with juvenility of leaf form. Thus adventitious shoots from the root had juvenile foliage and rooted readily, while normal twigs or adventitious shoots from the trunk had adult foliage and failed to root. Auxin treatments were not studied.

From a practical point of view, as Gardner points out, it is of little use to make cuttings from one-year old plants since almost the whole plant is used. By taking advantage of the fact that up to 3 or 4 years old the ability to root is still present if auxin is supplied, our experiments show that white pine and many other "difficult" plants can be readily rooted and may be propagated vegetatively in a practical way. No doubt the responsive period can be extended another year or two and this will be further studied. In view of the representative nature of the trees we have used, including both gymnosperms and angiosperms, the above is doubtless a general principle, and for selection work it might be said that the problem of the rooting of "difficult" plants is partially solved.

The explanation of this ease of rooting is, however, by no means easy, and the theoretical problems are not solved but actually increased. It is difficult to associate the ease of rooting (as did Stoutemyer with *Malus*) with a stage of "juvenility," for two reasons; — firstly because many of the trees used do not show any definite juvenile characters, either of leaf or growth habit, at the age of 3–4 years,* and secondly because the effect is evidently quantitative rather than qualitative, the ease of rooting falling off steadily with increasing age. On the contrary, it is evident that there is a *physiological juvenility,* which is quantitative in character, and which controls the ease of rooting in presence of sufficient auxin. This physiological juvenility may or may not produce qualitative morphological differences, according to the species.

Further, along with the age effect must also be considered the differences within the plant, lateral shoots rooting better than terminal, and

*But note the difference between the foliage of 3-year old and 65-year old *Pinus Strobus* in Plate 231, figure 1.

basal pieces better than apical. In all these cases, not only is the rooting better in water controls but the increase due to auxin is also greater (see Plate 230, figure 2). Hence the differences cannot be due to differences in auxin content of the cuttings. The experiments with substances other than auxin, while admittedly very scanty, show clearly that these are not the main factors which are missing from old trees or from poorly-rooting cuttings in general. Some *internal factor* of an unknown kind is evidently concerned. It would be easy to postulate a special substance, whose formation decreases with age, and whose distribution within the plant is responsible for the differences in rooting of the different parts such as the "rhizocaline" postulated by Went (1934, 1938) and Cooper (1938). In this connection it is important to note that in *Taxus, Pinus, Tsuga* and *Picea,* very high auxin concentrations, sufficient to kill the base of the cutting, by no means prevent root formation, but roots are formed in good numbers above the killed zone. According to the theory of Went (see especially Cooper, 1938) the auxin should draw the "rhizocaline" down to the base of the cutting, and if the base is then cut off or allowed to rot away all the rhizocaline would be lost along with it. Our experiments, therefore, while by no means conclusive, do not support this view of auxin action. The data of Pearse (1938) on *Salix* also do not agree with those of Cooper on *Citrus*. Apart from the "rhizocaline" theory, however, it remains very probable that the *internal factor* is a special substance or group of substances.

It is, however, also possible that the differences in rooting ability between old and young, or between terminal, lateral and basal parts, are morphological in nature. Specifically, they might be due to the absence in the poorly-rooting cuttings of certain types of cell which are those responsible for root initiation. In view of the recent finding of Dorn (1938) that roots are apparently initiated in different cell layers in different plants this does not seem very probable but must still be considered. An anatomical study of rooted cuttings taken from a series of ages would throw light on this problem. As yet the evidence does not allow of any decision between these two possibilities.

SUMMARY

1. A study has been made of the vegetative propagation of a number of coniferous and deciduous trees which are known to form roots from cuttings only with extreme difficulty.

2. The most important single factor in rooting these "difficult" trees is the age of the tree from which cuttings are taken. The ease with which roots are formed (on cuttings of one-year wood) falls off steadily with

increasing age of the tree. This applies both in the presence and in the absence of auxin treatment.

3. When cuttings are taken from trees 3 to 4 years old, and treated with the optimal concentration of indole-acetic acid or other auxin, excellent rooting is obtained with white pine (*Pinus Strobus*), Norway spruce (*Picea Abies*), red oak (*Quercus borealis*), Norway maple (*Acer platanoides*) and to a less extent with American ash (*Fraxinus americana*).

4. The optimum concentration of auxin depends upon the material. Using aqueous solutions applied to the base for 24 hours, it varies between 25 and 400 mg. per liter.

5. In *Pinus* and *Picea,* lateral shoots root more readily than terminal, and in *Quercus* and *Acer,* the bases of the young plants root more readily than the apices.

6. Rooted lateral branches of *Picea Abies* retain their plagiotropic habit of growth for at least one year, while those of *Pinus* apparently do not.

7. Exposure of the bases of the cuttings to permanganate or hot water before auxin treatment did not promote rooting in any of the species.

8. Application to the Pinus cuttings of sugar solution, following treatment with auxin, increased the percentage rooting and decreased the mortality rate.

9. A second treatment with auxin some days after the first, or a treatment with vitamin B_1, may have a small beneficial effect.

10. In some conifers, notably *Tsuga canadensis* and *Picea pungens,* cuttings from old trees root exceedingly well if treated with auxin but not at all in absence of auxin.

11. Basal treatment with high auxin concentrations frequently inhibits development of the buds on cuttings, sometimes for several weeks. In other cases it may cause killing of the base, but this does not necessarily interfere with good root formation.

12. Root formation in presence of optimal auxin is apparently controlled by an internal factor whose amount and distribution varies with the location of the cutting on the tree and with the age of the tree.

TABLE 1.

EFFECT OF AGE OF THE TREE ON THE ROOTING OF WHITE PINE CUTTINGS.

Age of tree in years	Percentage of cuttings rooting in auxin of concentration:				Approximate time for rooting in weeks.
	0	100	200	400 mg. per liter	
½ to 1	31	20	—	—	6
2	18	46	—	—	7
3	1	10	31	50	11
3 (another experiment)	18	36	37	27	8
10	0	0	—	—	
65	0	0	0*	0*	15 to 21

* Occasional rooting but less than 1%.

TABLE 2.

EFFECT OF AGE OF THE TREE ON THE ROOTING OF SPRUCE, MAPLE, ASH AND OAK CUTTINGS.

All data the mean percentage rooted, terminal and lateral cuttings being combined. Auxin concentration 100–200 mg. per liter.

Species	Age of tree from which cuttings were taken (years).							
	½		2		3 and 4		60 or over	
	Water	Auxin	Water	Auxin	Water	Auxin	Water	Auxin
Picea Abies	—	—	—	—	35	78	0	0
Acer platanoides	67	7	40	60	31*	30*	—†	—†
Fraxinus americana	—	—	—	—	0	7	0	1
Quercus borealis	—	—	—	—	9.5	18	0	0

* Combined data from 3, 4 and 5 years.
† Occasional rooting but less than 1%.

TABLE 3.

EFFECT OF AUXIN TREATMENT ON THE ROOTING OF CUTTINGS FROM OLD TREES OF VARIOUS CONIFERS.

All data the mean percentage rooted, terminal and lateral cuttings being combined.

Species	Month in which the cuttings were taken.	Auxin concentration in mg. per liter.					Approximate time for rooting in weeks.
		0	50	100	200	400	
Taxus baccata repandens	October	40	—	95	—	100	24
Taxus cuspidata	June	0	—	—	29	—	10
Tsuga canadensis	October	0	—	8	—	79	10
Tsuga canadensis	October	0	—	50	—	100	21
Tsuga canadensis pendula	December	0	63	54	—	—	8 to 11
Picea pungens Moerheimii	April	0	—	80	60	14	8
Keteleeria Davidiana	December	0	—	100	—	—	7

TABLE 4.

EFFECT OF AUXIN TREATMENT ON THE ROOTING OF CUTTINGS FROM YOUNG TREES.

All data the mean percentage rooted.

Species and age	Month in which the cuttings were taken.	Auxin concentration in mg. per liter.				
		0	25	100	200	400
Pinus Strobus 3 years	October	38	—	30	—	55
Pinus Strobus 3 years	February	7	—	20	29	23
Pinus Strobus 3 years	March					
(laterals only)		27	—	48	51	33
(terminals only)		9	—	24	23	20
Picea Abies 3 years	April	35	72	78	—	78
Fraxinus americana 4 years	March	0	—	7	5	0
" " " "	"	0	—	25	—	—
Acer platanoides 2 to 5 years	June	33	—	44	32	14
Quercus borealis 4 years (basal parts only)	February	22	—	30	38	82

TABLE 5.

EFFECT OF NEUTRALIZATION OF INDOLE-ACETIC ACID SOLUTION.

Pinus Strobus, 3 years old; lateral and terminal combined. Cuttings taken in February. All data the mean percentage rooted in 10 weeks.

	Auxin concentration in mg. per liter.			
	0	100	200	400
Free acid	5	20	10	12
Potassium salt	5	12	18	10

TABLE 6.

COMPARATIVE PERCENTAGE ROOTING OF TERMINAL AND LATERAL SHOOTS.

Percentage rooting in 11 weeks.

Treated with water		Treated with auxin	
Terminal	Lateral	Terminal	Lateral
Pinus Strobus, 3 years old; taken in February			
7	25	28	43
3	30	15	68
19	25	70	77
23	47	33	100
11	9	20	34
Picea Abies, 3 years old; taken in April			
20	41	56*	87*

* Mean of 25, 100 and 400 mg. per liter auxin.

TABLE 7.

COMPARATIVE PERCENTAGE ROOTING OF DIFFERENT PARTS OF THE PLANT.

	Auxin concentration in mg. per liter.				Mean of all treated with auxin.
	0	100	200	400	
Quercus borealis, 4 years old; taken in February					
Terminal shoots	8	3	9	2	5
Lateral shoots	0	0	8	0	3
Basal parts (cf. table 4)	22	30	38	82	55
Acer platanoides, 4 and 5 years old; taken in June					
Terminal shoots	0	—	—	—	18
Basal parts	—	—	—	—	50

TABLE 8.

PERCENTAGE ROOTING IN THREE MEDIA.

Material	Treatment	Peat	Peat and Sand	Sand
Pinus Strobus laterals	Auxin 100 to 400 mg. per liter	36	50	34
Taxus baccata all parts	Auxin 100 mg. per liter	87	—	73
Quercus borealis all parts	Mean of all	—	12	9
Quercus borealis basal parts	Auxin 100 mg. per liter	—	30	22

TABLE 9.

EFFECT OF THE BASAL APPLICATION OF PERMANGANATE PREVIOUS TO AUXIN TREATMENT.

Species and month	Pretreatment	Auxin concentration in mg. per liter.			
		0	25	100	400
Tsuga canadensis					
September	Water	0	—	50	100
(*% rooting*)	$KMnO_4$	0	—	0	75
Picea Abies					
October	Water	63	78	78	89
(*% rooting*)	$KMnO_4$	22	67	55	67
Populus tremuloides					
October	Water	4	18	39	0*
(*No. of roots per cutting*)	$KMnO_4$	8	13	25	9

* Killed.

TABLE 10.

EFFECT OF SUGAR TREATMENT ON PERCENTAGE ROOTING AND ON SURVIVAL.

Material	First treated for 24 hours with:	Afterwards treated for 3 days with:	
		SUGAR	WATER
Fraxinus americana 70 years	Auxin 100 to 200 mg. per liter	11	0
Fraxinus americana 4 years	Auxin 100 to 200 mg. per liter	2	3
Pinus Strobus 3 to 4 years	Water	14	8
" "	Auxin 100 mg. per liter	17	5
" "	Auxin 100 mg. per liter retreated	22	6
Pinus Strobus	All auxin treatments Percentage still living after 10 weeks	36	15

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DESCRIPTION OF PLATES

PLATE 228

Fig. 1. *Pinus Strobus*. From 3-year old trees. Left to right, 400, 100, 0 mg. auxin per liter. After 10 weeks.
Fig. 2. *Picea Abies*. From 3-year old trees. Left to right, 400, 100, 25, 0 mg. auxin per liter. After 7 weeks.

PLATE 229

Fig. 1. *Tsuga canadensis*. From tree about 40 years old. Left to right, 400, 100, 0 mg. auxin per liter.
Fig. 2. *Tsuga canadensis* var. *pendula*. From tree about 50 years old. Left to right, 100, 50, 0 mg. auxin per liter.
Fig. 3. *Picea pungens*. From tree about 60 years old. Left to right, 400, 200, 100, 0 mg. auxin per liter.
All three after 9–10 weeks.

PLATE 230

Fig. 1. Average number of roots per cutting formed in 3 weeks on two species of *Populus* treated with water and auxin.
Fig. 2. Comparison of the percentage rooting of lateral and terminal shoots from 3-year old trees of *Pinus Strobus* and *Picea Abies*. The white columns represent the percentage rooting of the water controls, the black columns the additional percentage rooting resulting from optimal auxin treatment.
Fig. 3. *Picea Abies*. From 3-year old trees. Left, lateral; right, terminal. Photographed 3 months after rooting, during which the new growth above the arrow has taken place.

PLATE 231

Fig. 1. *Pinus Strobus*. Left to right, two laterals from 3-year old trees, two terminals from 3-year old trees, lateral from 65-year old tree. Photographed 6 months after rooting. Note vertical growth of laterals, also the difference in foliage between 3-year and 65-year trees.
Fig. 2. *Quercus borealis*. Basal cuttings from 4-year old trees. Left to right, 400, 200, 100, 0 mg. auxin per liter.

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FIG. 1

FIG. 2

THE VEGETATIVE PROPAGATION OF DIFFICULT PLANTS

FIG. 1

FIG. 2

FIG. 3

THE VEGETATIVE PROPAGATION OF DIFFICULT PLANTS

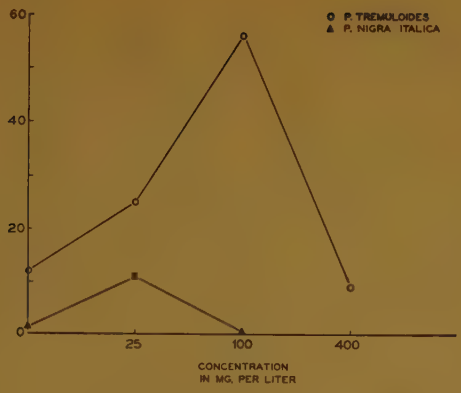

FIG. 1

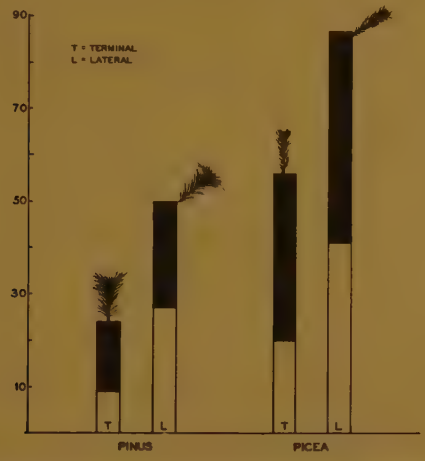

FIG. 2

THE VEGETATIVE PROPAGATION OF DIFFICULT PLANTS

THE VEGETATIVE PROPAGATION OF DIFFICULT PLANTS

BIBLIOGRAPHICAL NOTE ON "EHRH. PLANTAG."

Alfred Rehder

Ehrhart in his paper "Bestimmung einiger Bäume and Sträuche" published in his Beiträge zur Naturkunde, 6: 85–103 (1791) mentions in the synonymy a number of new names with the citation "Ehrh. plantag." So far no one seems to have found out to which publication this citation refers; if cited at all, it is cited as Ehrh. plantag. ex Ehrh. Beitr., as it is in Index kewensis. After a diligent search in contemporaneous literature, I came to the conclusion that Ehrhart's citation could not refer to any other publication than an anonymous list of trees and shrubs issued in 1787 under the title: Verzeichniss der Bäume und Sträuche welche sich auf der Königl. Plantage zu Herrenhausen bei Hannover befinden. 0.30 pp. [Hannover ?] 1787.

Since I was unable to locate this work in any American library, I wrote to Dr. L. Diels, Director of the Berlin Botanical Garden and Museum, who found it in the Staatsbibliothek in Berlin and kindly sent me a photostatic copy of it.

As Ehrhart cites it in his Beiträge as his own publication with the rather mystifying abbreviation "plantag." evidently taken from the word "Plantage" in the title, and as the numerous new names have their author cited as "E.," it is evident that Ehrhart is to be considered the author of this phamphlet.

The publication consists of a bare list of names with their authors, but without any descriptions, synonyms or notes. The new names and combinations bear only the author citation "E." and are all nomina nuda; there are about 210 such names. The names cited in Beiträge are found on the page indicated, and besides these, there are many more, particularly garden forms under *Amygdalus, Prunus* and *Pyrus*, all with the author citation "E." Since in the new combinations neither the synonym nor the original author is given they must technically be considered nomina nuda, even if there can be no doubt of the species which the combination represents, as in *Pyrus aucuparia* E. or *P. arbutifolia nigra* E.

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NOTE

VII. INTERNATIONAL BOTANICAL CONGRESS STOCKHOLM, 1940

MOTIONS dealing with Nomenclature for consideration by the Seventh International Botanical Congress, Stockholm, 1940, should be sent before July 1, 1939, to the Rapporteur général, Dr. T. A. Sprague, The Herbarium, Royal Botanic Gardens, Kew, Surrey, England.

Motions must be presented in the form of additional articles or amendments to the International Rules. They should be drafted as briefly as possible. At least 100 printed copies must be presented.

SECTION FOR TAXONOMY AND NOMENCLATURE

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